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Hydrology of the Martinsburg Formation in Lehigh and Northampton Counties, Pennsylvania

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COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF
ENVIRONMENTAL RESOURCES
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by Charles W. Poth
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Prepared by the United States Geological Survey, Water Resources Division, in cooperation with the Pennsylvania Geological Survey

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HYDROLOGY OF THE MARTINSBURG FORMATION IN LEHIGH AND NORTHAMPTON COUNTIES, PENNSYLVANIA

by
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Water Resources Division

ABSTRACT

The Martinsburg Formation underlies the northern half of Lehigh and Northampton Counties, and is of Middle and Late Ordovician age. It is bounded on the south by older Ordovician limestone formations and on the north by a ridge-forming conglomerate of Silurian age. Recent mapping has supported a three-part division of the Martinsburg into a lower thin-bedded slate (Bushkill Member), a middle graywacke-bearing unit (Ramseyburg Member), and an upper thick-bedded slate (Pen Argyl Member).

Glacial deposits of Illinoian age blanket about three-fourths of the area and become thinner westward and southward. Sands and gravels of Wisconsin age are present in the easternmost part of the area.

Ground water in the Martinsburg Formation moves through fractures and bedding-plane openings. The size, density, and degree of interconnection of the openings determine the water-yielding potential of the rocks. In many places the Martinsburg is overlain by thick, water-saturated beds of permeable sand and gravel of glacial origin that act as a natural reservoir and serve to increase the amount of water available to wells. The large yields of the wells along the slope of Blue Mountain, which supply the boroughs of Bangor and Slatington, are probably a result of this relationship.

Data were collected on 332 wells in Lehigh County and 402 wells in Northampton County. Fifty-four wells were test pumped for 1 hour; however, only one nondomestic well was available for testing. Chemical analyses of 36 water samples were made in the laboratory, and measurements of hardness and specific conductance of about 550 samples were made in the field.

The wells from which the data were collected were classified as either domestic or nondomestic, depending on the use for which the well was drilled, because the use generally determined the characteristics of the well. Public supply, industrial, commercial, institution, and irrigation wells make up the nondomestic category. The depths of the nondomestic wells average about twice those of the domestic wells (240 feet versus 125 feet in Lehigh County and 225 feet versus 112 feet in Northampton County). Also, the nondomestic wells yield about three to five times as much water as the domestic wells—36 gpm (gallons per minute) versus 13 gpm in Lehigh County and 75 gpm versus 15 gpm in Northampton County.

Well depths were generally least in the Pen Argyl Member and greatest in th Bushkill Member. Median yields of domestic wells were greatest in the Pen Argy and least in the Bushkill. Median yields of nondomestic wells were also greates in the Pen Argyl but showed no trend in the other members.

Specific capacities were computed from yield and drawdown data supplied b drillers and from 1-hour pumping tests conducted by U.S. Geological Surve personnel. The two sets of data yielded similar results. Their most outstandin feature is their wide range, as the largest specific capacity is 1,000 times th smallest. The specific capacities were greatest in the Pen Argyl Member an least in the Bushkill Member. The formation as a whole had a specific capacit of about 0.5 gpm per foot of drawdown.

Wells were generally deepest on uplands, shallower on slopes and shallowest i valleys. Yields and specific capacities were affected little by the topographi position of the well.

Casing depths furnished an estimate of the thickness of the glacial deposits i the area. In general the deposits thin southward and westward across Northamp ton County but show little trend in Lehigh County. Several narrow tongues o glacial deposits are more than 100 feet thick.

Yielding zones are most abundant between 50 and 150 feet below land su face, but they are sufficiently abundant to depths of about 400 feet to mak drilling to this depth worthwhile where maximum yields are needed. Most well tap two or three yielding zones.

Median static water levels were deepest in the uplands (40 feet below lan surface in Lehigh County and 30 feet in Northampton County) and shallowest i valleys (14 feet and 12 feet, respectively, in the two counties).

Chemical analyses show that the ground water has a median dissolved-solid content of 166 mg/l (milligrams per liter), but four samples range from 488 t 935 mg/l. The principal dissolved constituents are calcium, magnesium, bicar bonate, and sulfate ions. Most of the samples are low in iron, manganese, an fluoride. Approximately half the samples contained less than 8 mg/l chlorid and 0.5 mg/l nitrate. Higher concentrations are believed to be due to contam ination by the activities of man. Only two samples contained more than 45 mg/ nitrate (the limit suggested by the U.S. Public Health Service for drinking water)

About 5 percent of the wells contain hydrogen sulfide, chiefly in the lowe two members. The gas occurs naturally in the rocks and is formed by the an aerobic decomposition of sulfide minerals deposited at the time the sediment were laid down. The sodium-rich character of some of the water associated with the gas indicates that the water originally entrapped in the sediments has not been completely flushed out.

Field measurements of hardness and specific conductance indicate that wate in the Martinsburg becomes increasingly more mineralized from north to south The topographic position of the well apparently exerts little effect on the hard ness or conductance of the water.

PURPOSE AND SCOPE OF THE STUDY

This study is part of a continuing program to investigate the ground-water esources of Pennsylvania. The investigations are made by the U.S. Geological urvey in cooperation with the Pennsylvania Topographic and Geologic Survey.

The Martinsburg Formation was selected for study because it has one of the reatest areal extents of any geologic formation in southeastern Pennsylvania. Thus, a knowledge of the occurrence, movement, availability, and quality of the round water in the formation will aid in the efficient economic development of his part of the state.

LOCATION AND GEOGRAPHIC SETTING

The area in Northampton and Lehigh Counties underlain by the Martinsburg ormation lies between 75°00′ and 76°00′ west longitude and between 40°30′ nd 41°00′ north latitude. It includes parts of the Portland, Stroudsburg, Belidere, Bangor, Wind Gap, Kunkletown, Palmerton, Lehighton, Nazareth, Cataauqua, Cementon, Slatedale, New Tripoli, New Ringgold, Allentown West, opton, and Kutztown 7½-minute quadrangles (Figure 1).

The area lies in the Great Valley section of the Valley and Ridge province. t is maturely dissected and slopes gently southeastward. The highest part of the Martinsburg is along the flank of Blue Mountain in Lynn Township, Lehigh County, where it reaches an altitude of about 1,370 feet. The lowest exposures of the Martinsburg are along the Delaware River in Lower Mount Bethel Township, Northampton County, at an altitude of about 230 feet.

The eastern part of the area underlain by the Martinsburg drains directly to he Delaware River, the central part drains to the Lehigh River, and the western part drains to the Schuylkill River.

The climate of this part of the Commonwealth is mild and humid. Data from he U.S. Weather Bureau station at the Allentown airport shows that the mean nnual temperature is 50.9° F and that the mean monthly temperature ranges rom 28.5° F in January to 74.1° F in July. The average annual precipitation is 42.25 inches and is fairly uniformly distributed throughout the year, although bout 57 percent falls during the period April through September (Kauffman, 1960, p. 8).

METHOD OF STUDY

An inventory was made of 402 wells in Northampton County and 332 wells n Lehigh County, and 1-hour pumping tests were made on 54 wells. Field measurements of hardness and specific conductance were made on water from about 550 of the wells. These well data are listed in Table 6 and the locations of the wells are shown in Plate 1. Chemical analyses of water from 35 wells and 1 spring were made in the laboratory and the results are given in Table 7.

WELL-NUMBERING SYSTEM

Wells cited in this report have been assigned an identification number and a location number. The identification number consists of a two-letter abbreviation

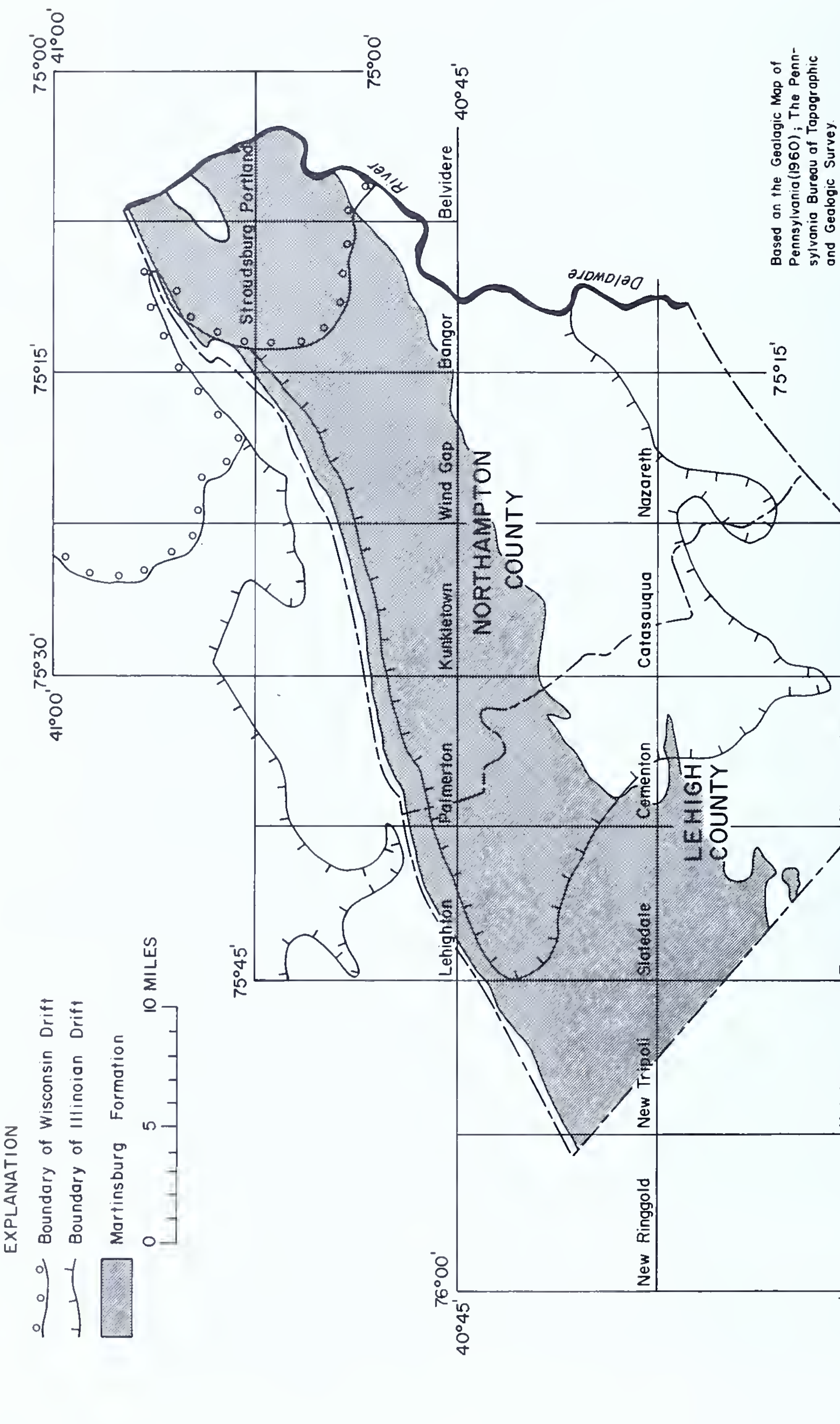

Figure 1. Location of the study area and boundaries of the glacial drift.

of the county in which the well is situated and a serial number that was assigned at the time the well was inventoried. The abbreviation is Le for wells in Lehigh County and Np for wells in Northampton County.

The location number is a four-digit number specifying the minutes of latitude and longitude of the southeast corner of the 1-minute quadrangle in which the well is located. As the study area lies entirely between 40° and 41° north latitude and 75° and 76° west longitude, the degrees have not been specified.

For example, well Np-258, location number 5012, was the 258th well scheduled in Northampton County and lies in the 1-minute quadrangle bounded on the south by latitude (40°) 50′ and bounded on the east by longitude (75°) 12′.

PREVIOUS INVESTIGATIONS

Many reports have been written about the Martinsburg Formation in Lehigh and Northampton Counties; however, only a few need be mentioned here. An excellent bibliography of the general area is given by Miller (1939, p. 12) in his report on Northampton County. In the same report, the Martinsburg Formation is discussed by Miller and Behre (1939, p. 263). Willard (1941, p. 213) discusses the Martinsburg in Lehigh County. Recently the formation has been restudied by Davis and others (1967), Drake and Epstein (1967), Epstein and Epstein (1967), and Drake and others (1969).

A reconnaissance of the ground water in the Martinsburg was described by Hall (1934) in a report on ground water in southeastern Pennsylvania.

ACKNOWLEDGMENTS

The author expresses his thanks to the many well owners who furnished information on their wells or allowed them to be test-pumped or sampled. Particular thanks are due well drillers Robert S. Kocher of Nazareth, Elmer C. Lenhart of Reading, R.H. Odenheimer and Co. of Allentown, Russell Pugh of Slatington, Floyd O. Rapp of Nazareth, Harry E. Todd of Allentown, Raymond E. Werner of Easton, and Clarence F. Wink of Hamburg, who supplied information on wells they had drilled in the area. The author is also indebted to borough officials E. G. Abbott and Arthur Stout of East Bangor, Carl Barrall of Bath, and H. S. Pensyl of Portland; and to water managers Fred Baker of the Bangor Water Co. and Franklin B. Bushkirk of the Blue Mountain Consolidated Water Co., who made available information on the wells under their supervision.

GEOLOGY

MARTINSBURG FORMATION

The Martinsburg Formation consists dominantly of fine-grained clastic rocks that stratigraphically overlie calcareous beds of Middle Ordovician age and underlie a ridge-forming conglomerate of Silurian age. It has been variously subdivided

into either two or three members (Drake and Epstein, 1967). The number o members delineated by different geologists has depended in large part on thei interpretation of the geologic structure. Those geologists recognizing only tw members have visualized the Martinsburg as being folded into a syncline in whicl a lower slate member forms the flanks of the syncline and an upper sandston member occupies the central part of the syncline. Those geologists delineatin three members believe the structure to be essentially monoclinal and the for mation to consist of a lower slate member, a middle sandstone member, and a upper slate member.

Recent detailed mapping supports the three-part subdivision of the Martins burg and shows that although the structure has the superficial appearance of monocline, it is much more complicated. Drake and Epstein (1967, p. 6) describ the structure as a

> . . . highly complicated, refolded, crystalline-cored nappe de recouvrement- the Musconetcong nappe. The Martinsburg in this area lies mainly in th normal limb and imbricated brow of this nappe and has the appearance of northwestward-dipping monocline . . . Progressively younger rocks are exposed from south to north across the outcrop belt, but locally the sequenc is overturned, especially in the Wind Gap-Pen Argyl area, Pennsylvania.

Drake and Epstein (1967) have named the three members, from lower t upper, the Bushkill, Ramseyburg, and Pen Argyl Members. Their nomenclatur and stratigraphy are followed in this report.

Most of the commercially valuable slate from the formation has been quarrie in the Pen Argyl Member or in the upper part of the Ramseyburg. Some lov grade slate was formerly taken from the Bushkill.

Glaciers advanced into the area at least twice during the Pleistocene Epoch and each time movement was westward along the valley rather than over Kitta tinny Mountain. The ice flowed over the mountain only in the vicinity of Dela ware Water Gap. The Illinoian glacier extended much farther westward than th younger (Wisconsin) glacier, covering all of the Martinsburg in Northampto County and about half of it in Lehigh County. The Wisconsin ice reached onl 8 to 9 miles west of the Delaware River (Figure 1).

Bushkill Member

The Bushkill Member, or lower member, of the Martinsburg Formation is dark-gray, thin-bedded claystone slate that weathers to a medium to light gray o yellowish brown. In places it contains thin beds of quartzose and graywack siltstone and carbonaceous slate. On Bushkill Creek, seven beds of dolomite 6 to 12 inches thick, occur between 20 and 250 feet above the base of the for mation (Drake and Epstein, 1967, p. 6-8). Bedding in the Bushkill appears generally, as bands of different color or composition. Slaty cleavage is dominant

The Bushkill overlies carbonate rocks conformably along most of the lowe contact, although some fault contacts are present locally. Where the contact i

onformable, the member grades from the carbonate rocks through a narrow one in which the calcium carbonate content decreases. The upper contact is lso gradational and is placed beneath the lowest prominent graywacke bed.

The member is estimated to be about 4,000 feet thick, but the estimate may e high because of undetected repetition of beds by faulting or folding.

Ramseyburg Member

The Ramseyburg Member, or middle member, consists of a series of alternating eds of light- to medium-gray claystone slate, graywacke siltstone, and fine- to nedium-grained (locally finely conglomeratic) graywacke that weathers to yellowsh brown. The slate in the lower 200 feet resembles that of the underlying Bushkill but becomes progressively thicker bedded upward, taking on the characeristics of the overlying Pen Argyl Member (Drake and Epstein, 1967, p. 9-12). The graywacke, which constitutes about 20 to 30 percent of the member, is yclical in character. Each bed commonly represents a single cycle that grades ipward from graywacke to medium-gray slate to grayish-black carbonaceous late. Some of the cycles are incomplete. The beds are commonly lenticular and ange from less than 1 inch to more than 4 feet in thickness.

The graywacke beds become progressively thinner as the Ramseyburg grades nto the Pen Argyl and give way to thin beds of quartzose slate or subgraywacke iltstone. The top of the Ramseyburg is placed at the top of the highest promnent graywacke interval. East of the Delaware River the Ramseyburg is overlain inconformably by the Shawangunk Formation of Silurian age.

The claystone has a well-developed slaty cleavage that is typical of the entire ormation. The graywacke is also broken by a poor to good fracture cleavage hat grades into flow cleavage in intensely deformed areas. The cleavage is ommonly refracted where it passes from slate into graywacke.

The member is estimated to be about 2,800 feet thick. It is somewhat thicker toward the southwest, where the graywacke beds are lower in the unit.

Pen Argyl Member

The Pen Argyl Member, or upper member, is a dark-gray to blackish claystone late that weathers to yellowish brown. It is regularly intercalated with thin beds of quartzose slate and carbonaceous claystone slate. A typical cycle grades rom quartzose slate to thick-bedded claystone slate to carbonaceous slate. The quartzose beds are coarse grained. Their average thickness is about 1 foot but nay be as much as 3 feet. The slate beds, on the other hand, are commonly about 5 feet thick but may be as much as 15 feet thick. Slaty cleavage is well leveloped in this member, and a second-generation slip cleavage is present locally.

The Pen Argyl Member is estimated to be between 3,000 and 6,000 feet thick. The thickness is difficult to determine because the member is covered nearly everywhere by glacial deposits and because the Shawangunk Formation overlies unconformably an unknown thickness of the Pen Argyl.

GLACIAL DEPOSITS

The glacial deposits consist of poorly sorted till and well-sorted outwash and ice-contact deposits. The Illinoian deposits are deeply weathered to dark brown, in contrast to the less weathered, generally buff Wisconsin drift. The older (Illinoian) deposits are composed predominantly of the most resistant rock types (quartzite, conglomerate, and sandstone). Limestone is almost totally absent and granite and gneiss are rare (Ward, 1938, p. 46). The matrix of the Illinoian till is more compact than that of Wisconsin age.

The amount of casing used in a domestic well is a fairly accurate measure of the thickness of the glacial, weathered, or other unconsolidated rocks present at any particular place. In Northampton County glacial deposits comprise the bulk of the unconsolidated rocks and thin southward and westward. The median casing depths given in Table 1 for each of the members reflect the change in thickness from north to south. Narrow tongues of glacial sand and gravel more than 100 feet thick are present along the north edge of the area. Four such tongues lie in the areas just east of Danielsville, Youngsville, and Delabole, and in the area extending from the Delaware River to the vicinity of Johnsonville and Totts Gap School (Plate 1).

No trend in the thickness of the glacial deposits is evident in Lehigh County. However, several wells contain more than 100 feet of casing. These wells are either near the north edge of the formation, where the glacial sands and gravels are locally thicker, or near the south edge of the formation, where tectonic movements have promoted deeper weathering of the bedrock.

HYDROLOGY

PRINCIPLES OF GROUND-WATER OCCURRENCE

Ground water is precipitation that has infiltrated downward through soil and openings in the rocks to a zone within which all interconnected openings are filled with water under pressure equal to or greater than atmospheric. The upper surface of this zone is at atmospheric pressure and is called the water table. Ground water moves continuously from points of high hydraulic head to points of lower hydraulic head and eventually to places of discharge such as a spring, a stream, or a well.

When water is added to the ground-water reservoir (aquifer) at a faster rate than it can be discharged, the water level rises in the aquifer. The amount of recharge an aquifer receives depends primarily upon the amount and distribution of precipitation. In the area of investigation recharge occurs mainly during the winter and spring months, although slightly more precipitation falls between April and September than between October and March. High temperatures and the growth of plants cause the evapotranspiration of nearly all precipitation during the warmer months. By the middle of May, generally, water levels begin to decline and may continue to do so past the period of high temperatures and the growing season. A cool and unusually wet summer and fall may allow recharge

Table 1. Summary of Well Data

County	Type of well	Well position	Well depth: Number of wells	Well depth: Median (feet)	Well depth: Range (feet)	Casing depth: Number of wells	Casing depth: Median (feet)	Casing depth: Range (feet)	Reported yield: Number of wells	Reported yield: Median (gpm)	Reported yield: Range (gpm)	Static water level depth below land surface: Number of wells	Static water level: Median (feet)	Static water level: Range (feet)
Lehigh	Bedrock domestic wells	Pen Argyl Member	49	103	58–300	43	30	12–103	37	15	7–43	41	22	Flowing–100
		Ramseyburg Member	98	115	53–690	84	30	6–282	70	13	2–50	90	25	Flowing–150
		Bushkill Member	111	156	42–600	94	26	2–130	80	10	¾–60	91	35	2–218
		Uplands	77	165	76–690	65	30	7–282	64	13	¾–60	62	45	7–200
		Slopes	103	125	52–600	89	30	2–130	78	13	1–50	93	30	Flowing–218
		Valleys	78	102	42–315	67	23	6–100	45	13	3–45	67	14	Flowing–100
		Formation as a whole	258	125	42–690	221	30	2–282	187	13	¾–60	222	30	Flowing–218
	Bedrock non-domestic wells	Pen Argyl Member	11	202	160–710	9	44	16–194	10	144	45–374	10	24	2–80
		Ramseyburg Member	10	320	62–410	7	41	20–70	10	25	10–105	9	4	Flowing–83
		Bushkill Member	48	241	67–700	36	33	8–84	46	26	2–230	39	25	Flowing 176
		Uplands	7	410	150–700	4	51	21–70	7	35	7–110	6	42	38–83
		Slopes	30	250	110–710	23	56	20–194	28	62	2–374	26	30	2–130
		Valleys	32	208	62–700	25	25	8–68	31	28	10–230	26	6	Flowing–176
		Formation as a whole	69	240	62–710	52	38	8–194	66	36	2–374	58	22	Flowing–176
Northampton	Bedrock domestic wells	Pen Argyl Member	54	105	36–305	42	58	15–225	28	25	5–100	45	20	Flowing–55
		Ramseyburg Member	131	120	35–355	103	30	6–170	81	15	2–65	101	20	Flowing–133
		Bushkill Member	149	115	43–580	111	20	3–139	89	11	⅓–90	115	20	Flowing–144
		Uplands	57	140	60–580	40	20	3–60	39	12	⅓–60	42	30	5–141
		Slopes	204	110	36–555	153	30	3–170	110	12	2–70	161	20	Flowing–133
		Valleys	73	102	35–275	63	33	5–225	49	20	5–100	58	12	Flowing–60
		Formation as a whole	334	112	35–580	256	28	3–225	198	15	⅓–100	261	20	Flowing–141
	Bedrock non-domestic wells	Pen Argyl Member	25	158	38–1,177	20	117	38–401	14	122	50–360	17	Flowing	Flowing–90
		Ramseyburg Member	8	225	67–800	5	90	25–500	3	17	15–150	5	29	Flowing–165
		Bushkill Member	13	335	160–700	10	33	8–150	10	42	6–80	13	19	Flowing–51
		Uplands	3	400	170–590	3	100	20–500	2	55	50–60	2	21	Flowing–51
		Slopes	28	169	38–1,177	22	106	25–401	18	106	6–360	20	Flowing	Flowing–165
		Valleys	15	268	67–700	10	42	8–150	7	33	12–80	13	22	Flowing–90
		Formation as a whole	46	225	38–1,177	35	94	8–500	27	75	6–360	35	10	Flowing–165
	Glacial deposits	Domestic wells	12	72	35–180	11	74	45–180	7	20	9–80	9	8	Flowing–30
		Non-domestic wells	4	78	66–110	3	84	72–110	3	75	50–230	3	24	Flowing–28
		Combined	16	73	35–180	14	77	45–180	10	40	9–230	12	12	Flowing–30

to occur a few weeks earlier than usual and may hold water levels slightly above their normal lows, but little recharge occurs during the growing period.

In unconsolidated rocks, such as the glacial sands and gravels, water is present in and moves through the interstices between the grains (called primary openings). Water enters a well drilled in these materials throughout the entire saturated thickness of the aquifer that is open to the well. In consolidated rocks, such as the sandstone and shale of the Martinsburg Formation, the water occurs mainly in fractures (called secondary openings), so that a well in these rocks receives water only through a few discrete zones that are separated from each other by nonproductive zones.

Changes in the lithology of the unconsolidated rocks or in the fracture pattern in the consolidated rocks produce changes in their permeability and storage capacity. If the hydraulic conductivity of the rocks increases away from a well, the drawdown in the well during pumping will increase less rapidly than it would if the hydraulic conductivity were uniform; if the hydraulic conductivity decreases away from the well, the drawdown will increase more rapidly.

FRACTURE TRACES

Fracture traces are natural linear features that are visible on aerial photographs, and are believed to be surface expressions of fractures in the underlying bedrock. In areas underlain chiefly by fractured rocks such as the present study area, where most of the ground water occurs in fractures rather than in pore spaces, a knowledge of the location of the fractures is helpful in developing ground-water supplies. For this reason, the locations of fracture traces are shown in Plate 1. However, time did not permit the checking of these features in the field.

According to Lattman (1958, p. 569), fracture traces consist of topographic (including straight stream segments), vegetational, or soil-tonal alignments, which are visible primarily on aerial photographs, and are expressed continuously for less than 1 mile. Similar features that are expressed continuously for at least 1 mile, and continuously or discontinuously for several miles, are defined as lineaments and are considered to be due to deep-seated movements.

Fracture traces do not include linear features that are obviously related to bedding, striation, foliation, and stratigraphic contacts. They are believed to be related to individual joints, zones of closely spaced joints, or small-scale faults. Inasmuch as these features remain straight over irregular topographic surfaces, they are believed to be steeply inclined. Traces of slightly to moderately inclined fractures would be sinuous in areas of substantial relief and probably would not be recognized as fracture traces on aerial photographs.

Fracture traces were identified and plotted on photographs at a scale of approximately 1:20,000, first with the unaided eye, then with a stereoscopic lens. Projections of the photo were then reduced to a scale of 1:24,000 and the fracture traces were transferred to topographic maps of that scale. Few fractures were plotted in forested sections because of the difficulty in distinguishing the numerous woodlot lines of past timbering operations from natural linear features.

Table 2. Summary of Data on Water-Bearing Zones

County	Well Position	Ratio of number of water-bearing zones of specified depth range to number of wells penetrating this range[1] (depth, in feet)																	Percentage distribution of zones per well (zones per well)					
		0–51	51–100	101-150	151–200	201–250	251–300	301–350	351–400	401–450	451–500	501–550	551-600	601-650	651-700	701-750	751–800	Depth >800	1	2	3	4	5	6
Lehigh	Pen Argyl Member	21/39	37/39	23/25	7/11	1/5	1/4	1/3	1/3	0/3	1/3	1/3	0/2	2/12	0/2	0/1			13	28	51	5	3	
	Ramseyburg Member	27/72	63/72	29/55	17/30	6/20	6/12	3/9	2/9	0/2	0/1	0/1	0/1	0/1	1/1				28	32	36	4		
	Bushkill Member	15/68	55/68	30/62	26/31	8/33	8/18	3/13	1/7	0/6	3/4	1/4	0/4	0/2	1/1				29	43	16	6	3	3
	Uplands	15/54	44/54	27/48	21/36	8/23	4/12	2/10	3/7	0/5	2/3	0/3	0/3	0/2	1/1				20	39	33	6	0	2
	Slopes	26/76	68/76	39/62	15/35	3/24	7/14	4/9	1/5	0/5	2/4	2/4	0/3	2/2	0/2	0/1			24	34	33	6	3	
	Valleys	22/49	43/49	16/32	14/31	4/11	4/8	1/6	0/1	0/1	0/1	0/1	0/1	0/1	1/1				33	33	28	2	2	2
	Formation as a whole	63/179	155/179	82/142	50/92	15/58	15/34	7/25	4/13	0/11	4/8	2/8	0/7	2/5	2/4	0/1			25	35	32	5	2	1
Northampton	Pen Argyl Member	3/18	16/18	8/13	2/4	0/3	1/3	1/3	1/2	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1,030	39	44	17			
	Ramseyburg Member	23/66	51/66	19/48	8/23	7/14	1/4	0/2	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	1/1		53	33	9	3	2	
	Bushkill Member	26/61	37/61	16/46	13/27	3/12	3/6	0/2	1/2	0/1	0/1	0/1	1/1						48	44	6	0	2	
	Uplands	12/28	18/28	9/24	5/10	0/4	2/3	1/3	1/2	0/1	0/1	0/1	1/1						39	50	11			
	Slopes	25/82	64/82	25/62	13/35	9/21	2/9	1/5	1/3	0/2	0/2	0/2	0/2	0/2	0/2	0/2	1/2	0/1,030	48	38	11	2	1	
	Valleys	15/35	22/35	9/21	5/9	1/4	1/1												60	34	3	0	3	
	Formation as a whole	52/145	104/145	43/107	23/54	10/21	5/13	1/7	2/5	0/3	0/3	0/3	1/3	0/2	0/2	0/2	1/2	0/1,030	49	39	9	1.5	1.5	

[1] The numerator of the fraction is the number of water-bearing zones and the denominator is the number of wells sampled in the particular depth range.

zones penetrated by the well. Wells in Lehigh County penetrating 5 or 6 zones and in Northampton County penetrating 4 or 5 zones are too few to furnish a meaningful median yield.

Well Yields

The capacity of a well to yield water is generally tested at the time the well is drilled. The rate at which water must be withdrawn from the well either by bailing (if the well was drilled with a churn drill) or by blowing (if the well was drilled with a pneumatic rotary drill) to maintain the water level near the bottom of the well is considered to be the yield of the well. The carefulness with which the water level is maintained near the bottom of the well during the test is an important factor in determining the accuracy of the measurement of the yield. The depth to water is generally estimated only roughly in this type of test, however, so that yield figures are less satisfactory than specific capacities for estimating the well's capacity. (See next section.) Inasmuch as yields are commonly reported on wells, they are used in this report as a guide to the capacity of the well or aquifer. Data on well yields are summarized in Table 1 and on specific capacities in Table 3.

Pen Argyl Member

Half the domestic wells in the Pen Argyl yield 15 gpm or less in Lehigh County and 25 gpm or less in Northampton County. The median yield of the non-domestic wells is 144 gpm in Lehigh and 122 gpm in Northampton. About one-fourth of the wells in the member as a whole yield more than 50 gpm and 17 percent yield over 100 gpm. Most of the high-yielding wells are along the slope of Blue Mountain. Only one well yields less than 5 gpm.

Ramseyburg Member

Half the domestic wells in the Ramseyburg yield 13 gpm or less in Lehigh County and 15 gpm or less in Northampton County. The median yield of non-domestic wells is about twice that of the domestic wells in Lehigh County; but, as data on only three nondomestic wells in Northampton County are available, evaluation and comparison of these wells are not warranted. Only 7 percent of the wells in the member yield more than 50 gpm and only 2 wells yield more than 100 gpm. Five percent of the wells yield less than 5 gpm.

Bushkill Member

Half the domestic wells in the Bushkill in both Lehigh and Northampton Counties yield about 10 gpm or less. On the other hand, half the nondomestic wells yield less than 26 gpm in Lehigh County and less than 42 gpm in Northampton County. Only 8 percent of the wells in the two counties yield more than 50 gpm, although about half of these yield over 100 gpm. Sixteen percent of the wells yield less than 5 gpm.

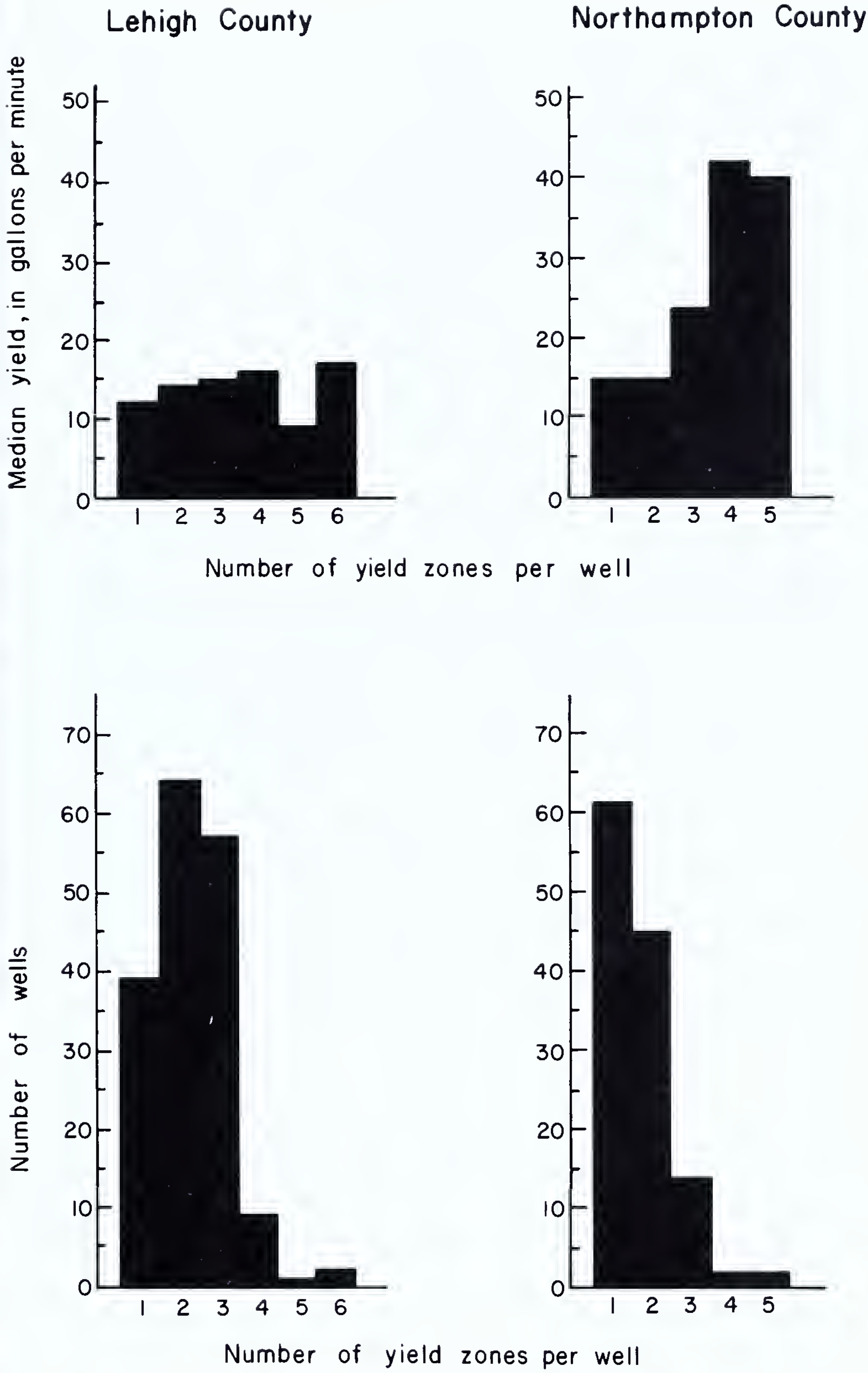

Figure 2. Relation of the yield of wells to the number of water-bearing zones.

The topographic position of domestic wells in the Martinsburg Formation apparently has little effect on their yield; only the valley wells in Northampton County (median yield 20 gpm) obtain more than the median yield of 12 to 13 gpm reported for all topographic positions in the two counties. Nondomestic wells on slopes have a median yield of 62 gpm in Lehigh and 196 gpm in Northampton County—five to nine times as much as domestic wells—and yield two to three times as much as nondomestic wells on uplands and in valleys.

Glacial Deposits

Yields are reported on 10 wells drilled in glacial material in Northampton County; all but one were drilled for domestic use. The median yield is 40 gpm—nearly three times that of the domestic bedrock wells in the county, but the median depth is only about two-thirds that of the bedrock wells. The smallest yield reported is 9 gpm.

Specific Capacities

The specific capacity of a well is the amount of water, in gallons per minute, that may be pumped from a well for each foot that the water level is lowered in the well. It may be used to estimate the approximate rate at which the well can be pumped for any assumed drawdown. The estimate becomes less accurate as the pumping rate is increased because the water has increased difficulty entering the borehole due to the increased turbulence. The amount of turbulence is due to such factors as the velocity of the water, the size of the openings in the rock around the well through which the water flows, and the diameter of the borehole.

A specific capacity is a more accurate estimate of a well's capability of yielding water than the commonly reported yield figure, because it is not necessary to assume, in computing the specific capacity, that the water level was maintained at any particular drawdown (as at the bottom in the case of yield). Rather, the water level need only be measured near the end of the pumping and then divided into the average rate of discharge.

Both specific capacity and yield decrease slowly as pumping continues. Furthermore, both values decrease as the water level in the well declines below a yielding zone.

Two sets of measurements of specific capacity are presented in Table 3. Recent state regulations require drillers to submit well-completion reports that include, along with other well data, the rate at which the well was test pumped and the drawdown near the end of the test. Specific capacities computed from these data are tabulated as reported capacities. Unfortunately, the well inventory in Northampton County was completed before many of the data were available. Pumping tests of about 1-hour duration were made on 54 wells by personnel of the U.S. Geological Survey. Specific capacities computed from these data are tabulated as 1-hour specific capacities.

The most outstanding feature of these data is their great variability; the largest

specific capacity is 1,000 times the smallest. In most categories, therefore, the sample size is too small to permit adequate evaluation. Perhaps the reported capacities only of domestic wells in Lehigh County are sufficiently abundant to properly represent the median values in the several categories. The 73 reported values are fairly evenly distributed and indicate a progressive decline, from the Pen Argyl to the Bushkill Members, in the aquifer's capability of yielding water. Further, wells on uplands and slopes have similar yields, but they yield considerably less than wells in valleys. The median specific capacity of the formation is about 0.5 gpm per foot of drawdown.

Well Interference

When two or more wells are drilled within a small area, the pumping of one of the wells may lower the water level in the other well(s) and so interfere with the performance of the other well(s). In a homogeneous and isotropic aquifer the effects of pumping may be readily calculated for any distance, direction, or duration and rate of pumping if the transmissivity, or rate at which water can be moved through the aquifer, and storage coefficient of the aquifer are known. These coefficients may be calculated if an initial test is made in which the pumping rate, the distance to a nearby well in the same aquifer, and periodic measurements of drawdown in the nearby well during pumping are measured.

Unconsolidated rocks commonly meet the theoretical requirements for such calculations; however, consolidated rocks rarely do, because their water is confined to a few narrow channels such as fractures or bedding planes, so that the aquifer is extremely inhomogeneous and anisotropic. Under such conditions complete hydraulic connection between two wells is not likely to obtain.

If two nearby wells in a consolidated-rock aquifer are drilled along the same fracture or bedding plane, or closely connected ones, the pumping of one of the wells will affect the other. A well along a line from the pumped well at right angles to the strike of these water-bearing openings will be negligibly affected. Wells situated at an intermediate angle will be affected to an intermediate extent. Calculation of aquifer coefficients under such complex conditions, then, is likely to be an intellectual exercise rather than a step toward the solution of problems in quantitative hydrology.

In the present study only two tests were made to determine the aquifer coefficients, transmissivity and storage. Transmissivity is a measure of the ability of the aquifer to transmit water and is defined as the quantity of water, in gallons per day, that will flow through a vertical section of the aquifer 1-foot wide and extending the full height of the aquifer under a unit hydraulic gradient at the prevailing temperature of the water. The coefficient of storage of an aquifer is the volume of water it releases from or takes into storage per unit surface area of the aquifer per unit change in the component of head normal to that surface. Well Np-487 was pumped and drawdown was measured in well Np-488. The wells were then allowed to recover to static conditions, and well Np-488 was pumped while the water level in well Np-487 was monitored. Agreement between

Table 3. *Summary of Specific-Capacity Data*

Type of well	Well position	Reported specific capacity						1-hour specific capacity					
		Lehigh County			Northampton County			Lehigh County			Northampton County		
		Number of wells	Median (gpm per ft)	Range (gpm per ft)	Number of wells	Median (gpm per ft)	Range (gpm per ft)	Number of wells	Median (gpm per ft)	Range (gpm per ft)	Number of wells	Median (gpm per ft)	Range (gpm per ft)
Bedrock domestic wells	Pen Argyl Member	22	0.62	0.12–3.5	3	2.3	1.0 –10	0	–	–	2	0.30	0.22– .37
	Ramseyburg Member	34	.30	.01–3.4	6	.42	.08– 6.7	1	0.85	0.85	11	.80	.09–3.9
	Bushkill Member	17	.16	.01–3.6	4	1.0	.23– 3.0	13	.38	.08–1.9	13	.16	.04–2.5
	Uplands	24	.40	.01–3.6	1	1.2	1.2	5	.17	.05–1.9	4	.10	.04– .16
	Slopes	31	.34	.01–3.4	7	1.0	.15–10	8	.75	.03–1.2	14	.29	.04–3.9
	Valleys	18	.62	.04–2.1	5	.54	.08– 6.7	1	.25	.25	8	1.2	.16–2.6
	Formation as a whole	73	.44	.01–3.6	13	1.0	.08–10	14	.52	.03–1.9	26	.30	.04–3.9
Bedrock non-domestic wells	Pen Argyl Member	4	3.2	1.2 –4.2	3	2.1	.81– 3.2	2	2.4	.68–4.2	0	–	–
	Ramseyburg Member	3	.08	.03– .18	1	.06	.06	0	–	–	1	.46	.46
	Bushkill Member	18	.57	.01–7.9	2	.24	.06–41	10	.91	.04–8.6	1	.59	.59
	Uplands	3	.04	.01– .82	1	.41	.41	1	8.6	8.6	0	–	–
	Slopes	12	.76	.03–4.2	4	1.5	.06– 3.2	5	.68	.04–4.2	2	.52	.46– .59
	Valleys	10	.70	.03–7.9	1	.06	.06	6	.91	.09–1.7	0	–	–
	Formation as a whole	25	.63	.01–7.9	6	.61	.06– 3.2	12	.89	.04–8.6	2	.52	.46– .59

the results of the two tests was surprisingly good because they lay along a line nearly parallel to the strike of the water-bearing zones. When well Np-488 was the "observed" well the transmissivity was measured as 2,500 gpd (gallons per day) per foot of saturated thickness of the aquifer. When well Np-487 was "observed" the transmissivity obtained was 1,300 gpd per foot. In both tests a storage coefficient of 0.00003 was obtained.

Static Water Level

Knowledge of the static water level in a well is important in estimating the amount of available drawdown in the well—that is, the height of the static water above the zone(s) at which the water enters the well. The static water level constitutes an index of the recharge-discharge regimen of the water in the aquifer. As noted earlier (p. 8), the rate of recharge varies with time and depends chiefly on the weather. The rate of natural discharge tends to fluctuate less, being controlled in large part by the hydraulic characteristics of the aquifer and by the hydraulic gradients toward the discharge outlets. Changes in the hydraulic gradients are reflected by the seasonal fluctuations in water level in wells.

No records of seasonal water-level fluctuations were collected in wells in the Martinsburg in Lehigh and Northampton Counties; however, records obtained from wells drilled in this formation in Dauphin County (Carswell and Hollowell, 1968, p. 23) indicate that seasonal effects are fairly small. During the period of measurement (1962-63) water levels fluctuated about their means approximately 3-1/2 to 6 feet in wells in uplands and only about 1 to 2 feet in wells in valleys.

The topographic position of the wells appears to have more effect on the depth to water than do the seasonal factors. The median water level in Lehigh County wells in uplands is slightly more than 40 feet below the land surface, and in wells in valleys it is 14 feet in domestic wells and 6 feet in nondomestic wells. The median depth to water in domestic wells in Northampton County is 30 feet in upland wells and 12 feet in valley wells. The depths to static water level in nondomestic wells in Northampton County are about the same in uplands and valleys—possibly because of the unusually large amounts of casing used in these wells. The water levels in each category were collected over a period of several years, so that seasonal effects should be negligible.

WATER QUALITY

Samples of water from 35 wells and 1 spring were analyzed in the U.S. Geological Survey laboratory. The results are shown in Table 7 and are summarized in Table 4. In addition, field measurements of hardness and specific conductance were made on about 550 samples. The field measurements are listed with other well data in Table 6 and are summarized in Table 5.

The dissolved constituents in the water were derived, for the most part, from the solution of natural materials through which the water passed. Locally, other material has been added by the activities of man.

Table 4. *Summary of Chemical Analyses*

				(Results in milligrams per liter except field hardness and specific conductance)													Hardness as $CaCO_3$ Laboratory		Hardness as $CaCO_3$ Field	Specific Conductance (micromhos at 25°C)	
				Silica (SiO_2)	Total iron (Fe)	Total manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (CL)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue at 180°C)	Calcium, Magnesium	Noncarbonate	Calcium, magnesium (grains per gal.)[1]	Lab	Field
LEHIGH COUNTY	Geologic Member	Pen Argyl Member	Number of analyses	4	4	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
			Median	13	.03	.00	25	6.6	4	.6	57	22	5.5	.0	5.6	130	88	42	5	198	238
			Range	7.6-18	.02-3.6	.00-.01	3.5-37	1.3-13	2.0-7.5	.3-.9	12-90	5.7-53	.8-46	.0-.1	.1-13	30-255	14-146	2-72	1-9	42-356	50-400
		Ramseyburg Member	Number of analyses	8	8	6	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
			Median	12	.06	.00	28	6.4	8.2	.9	74	30	6.2	.1	14	153	91	32	6	264	300
			Range	10-15	.00-2.2	.00-.04	2-49	.4-10	3.9-74	.4-2.0	43-178	8.6-89	2-30	.0-1	.0-26	112-275	7-164	0-107	2-10	209-407	210-450
		Bushkill Member	Number of analyses	13	13	7	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
			Median	12	.10	.01	29	8	5.3	.8	72	43	5	.0	7.2	153	95	44	6	237	280
			Range	5.6-16	.02-.92	.00-.08	12-50	3.7-12	2.2-40	.3-1.6	34-160	8.4-75	2.2-27	.0-.1	.0-21	80-221	45-161	0-80	3-9	108-320	135-350
	Topographic Position	Uplands	Number of analyses	7	7	4	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
			Median	13	.09	.01	31	7.2	7.5	.9	95	34	7.6	.0	9.5	181	107	32	6	282	305
			Range	6.4-16	.00-.55	.00-.03	13-49	4.3-12	3.9-40	.3-1.5	34-160	20-65	6.0-30	.0-.1	.0-24	117-275	60-156	0-104	4-10	166-407	195-450
		Slopes	Number of anaylses	13	13	8	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
			Median	12	.08	.00	24	6.8	5.0	.8	66	35	4.5	.0	10	150	92	52	6	222	265
			Range	5.8-18	.00-3.6	.00-.08	2.0-50	.4-13	2.0-74	.3-2.0	12-178	5.7-75	.8-46	.0-1.0	.1-26	30-255	7-161	0-80	1-9	42-356	50-400
		Valleys	Number of analyses	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
			Median	11	.08	.01	22	6.2	7.6	.9	69	50	6	0	.2	141	86	32	5	237	280
			Range	5.6-15	.02-.40	.00-.01	6.0-49	3.0-10	6.2-40	.4-1.2	52-115	21-89	3-21	.0-.3	.0-22	112-249	28-164	0-107	2-10	214-358	210-370

NORTHAMPTON COUNTY	Geologic Member	Pen Argyl Member	Number of analyses	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
			Median	12	.15	.01	12	2.4	6.8	.35	52	8.5	2.1	.0	.1	70	39	3	3	100	100
			Range	6.9-17	.08-.21	.00-.02	7.3-16	1.5-3.2	1.2-12	.3-.4	22-81	7.2-9.8	2.0-2.2	.0-.0	.0-.2	36-104	24-53	0-6	2-4	55-145	55-145
		Ramseyburg Member	Number of analyses	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
			Median	12	.07	.01	38	4.8	4.8	.8	66	42	16	.0	9.6	186	115	67	6	263	260
			Range	11-16	.00-.07	.00-.78	13-105	3.8-22	4-40	.2-6.6	55-262	10-108	1.0-79	.0-.1	.4-99	80-548	48-353	3-182	3-19	115-815	110-800
		Bushkill Member	Number of analyses	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
			Median	10	.09	.00	52	13	87	2.8	202	64	82	.2	6.7	489	195	70	13	782	725
			Range	9.3-11	.00-.37	.00-.05	5.5-139	2.0-27	61-105	1.2-10	74-265	11-106	3-280	.0-1.5	.0-109	175-935	22-434	0-373	2-24	282-1370	290-1300
	Topographic Position	Uplands	Number of analyses	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
			Median	12	.00	.00	80	12	40	1.7	82	52	58	.0	9.6	488	249	138	16	632	600
			Range	9.5-16	.00-.37	.00-.78	5.5-139	2.0-22	4-105	.8-6.6	58-262	27-108	3-280	.0-.4	.3-109	175-935	22-434	0-373	2-24	263-1370	260-1300
		Slopes	Number of analyses	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
			Median	12	.08	.01	14	3.9	8.2	.35	74	10	2.1	.0	.3	96	50	3	3.5	136	132
			Range	6.9-17	.07-.21	.00-.03	7.3-97	1.5-27	1.2-95	.2-10	22-265	7.2-100	1.0-152	.0-1.5	.0-13	36-696	24-353	0-141	2-23	55-1100	55-1000
		Valleys	Number of analyses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Median	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
			Range	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lehigh County		Formation as a whole	Number of analyses	25	25	16	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
			Median	12	.08	.00	29	6.8	6.7	.8	69	35	6	.0	9.5	153	95	43	6	246	280
			Range	5.6-18	.02-3.6	.00-.08	2-50	.4-13	2-74	.3-2	12-178	5.7-89	.8-46	.0-1	.0-26	30-275	7-164	0-107	1-10	42-407	50-450
Northampton County		Formation as a whole	Number of analyses	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
			Median	11	.07	.00	16	4.2	14	1.2	81	27	12	.0	1.5	186	57	6	4	282	290
			Range	6.9-17	.00-.37	.00-.78	5.5-139	1.5-27	1.2-105	.2-10	22-265	7.2-108	1-280	.0-1.5	.0-109	36-935	22-434	0-373	2-24	55-1370	55-1300

[1]May be converted to milligrams per liter by multiplying by 17

Laboratory Analyses

Water in the Martinsburg Formation is moderately low in dissolved solids. Half the analyzed samples contain 166 mg/l (milligrams per liter) or less, and only four samples (all in Northampton County) exceed 281 mg/l. These four range from 488 to 935 mg/l. The dominant cations are calcium and magnesium. The ratio of calcium to magnesium ranges from 1.1 to 5.4 and is less than 3.0 in half of the samples. Sodium is the dominant cation in only five samples.

Bicarbonate is the most abundant anion and exceeds the sum of the other anions in more than half the samples. Sulfate is next in abundance, and generally makes up between 15 and 50 percent of the anions. Chloride and nitrate combined exceed 30 percent of the anions in only seven samples.

Several of the analyses indicate concentrations of one or more constituents in excess of that recommended by the U.S. Public Health Service (1962) for drinking water. Excessive amounts of iron and manganese impart an objectionable taste to water and cause staining of laundry. The Public Health Service recommends that concentrations of these elements should not exceed 0.3 and 0.05 mg/l, respectively. Six samples contained excessive iron, and two samples contained excessive manganese. High nitrate concentrations in water may cause infantile methemoglobinemia, or "blue-baby disease," which produces cyanosis in infants. Only two samples exceeded the maximum limit of 45 mg/l. Water containing more than 500 mg/l dissolved solids is not recommended by the Public Health Service for drinking, as concentrations above this amount generally impart an objectionable taste to water. Concentrations greater than 500 mg/l, however, will not necessarily have an injurious effect, and water containing such amounts may be used where other water is not available. Three of the analyses show more than 500 mg/l.

Contamination

Water may be contaminated without the concentration of the contaminants exceeding the maximum limits for drinking water recommended by the Public Health Service. It is important to know if ions such as chloride and nitrate are present in amounts greater than those in which they occur naturally, because these are the ions most commonly added from human and animal wastes and from other activities of man. Thus, these ions, though harmless in themselves, may be indicators of the presence of harmful bacteria.

To gain some idea of the natural concentrations of chloride and nitrate in the ground water of the Martinsburg, the analyses were arranged in order of increasing concentration to see if they formed a uniformly increasing series or if the series was marked by a pronounced discontinuity or sharp change. Figure 3 shows this ranking. The chloride series has a discontinuity at about 8 mg/l in Lehigh County and at 3 mg/l in Northampton County; approximately three-fourths and one half of the samples, respectively, had less than this amount of chloride. The discontinuity in the nitrate ranking occurs at about 0.5 mg/l in both counties; nearly half the samples had less than this amount of nitrate. High chloride is not

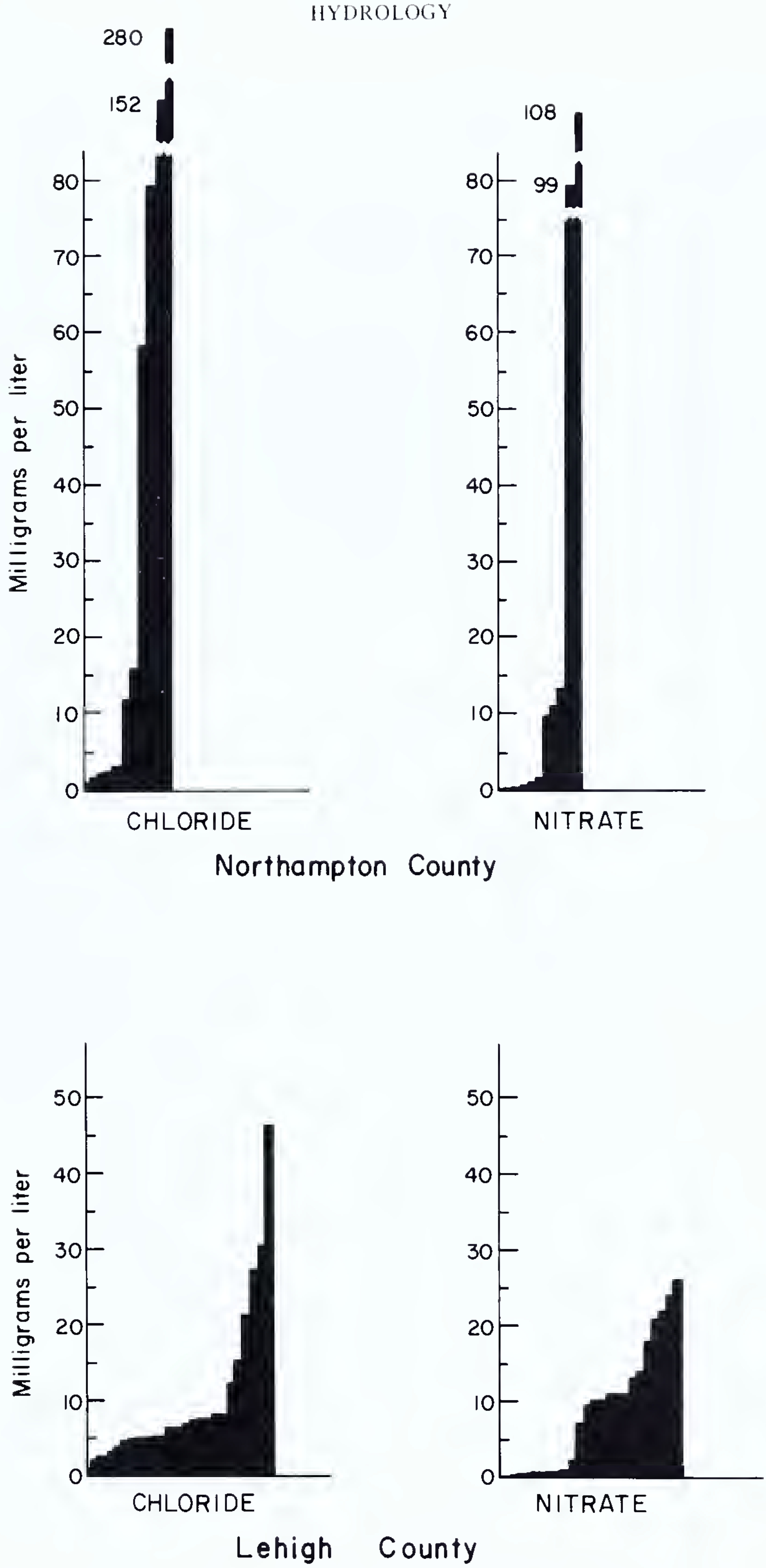

Figure 3. Ranked concentrations of chloride and nitrate. Each box represents one sample.

necessarily accompanied by high nitrate, however, as they may be derived, in part, from different sources. Calcium chloride, for instance, is added to highways in the winter to melt ice and is subsequently leached to the ground. The sharp discontinuity in the ranked concentration of both ions suggests, however, that values above the break are not derived naturally from these rocks. Samples of ground water that contain more of these ions than the amounts cited above should be checked for bacteria.

Occurrence of Hydrogen Sulfide

About 5 percent of the wells inventoried are reported to yield water containing hydrogen sulfide (H_2S). The gas occurs naturally in the Martinsburg Formation and does not necessarily indicate pollution. Although the gas has an unpleasant odor, it does not constitute a health hazard in the concentrations in which it normally occurs and may be removed by boiling the water.

About 92 percent of the H_2S-bearing wells are fairly evenly distributed be-

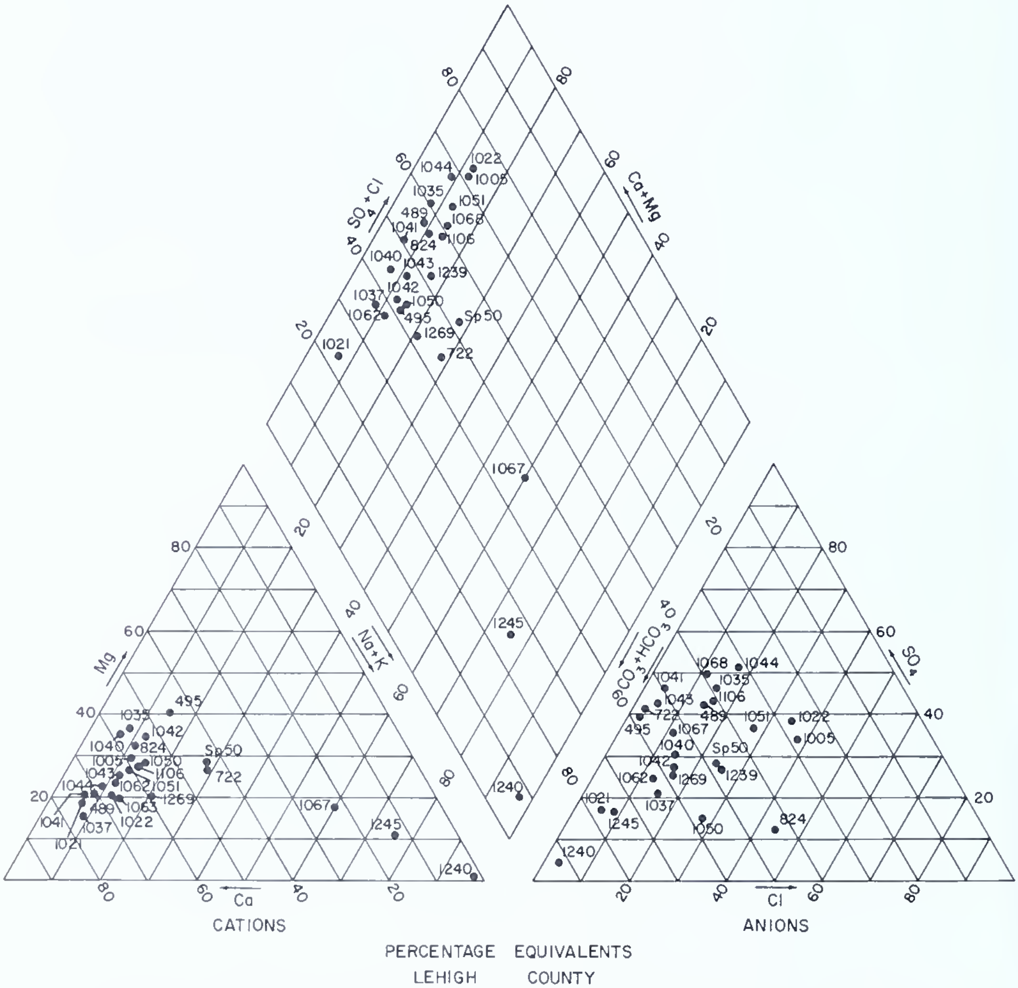

Figure 4. Chemical analyses of water in Lehigh County. Numbers are those of wells sampled.

tween the lower two members, and the remaining 8 percent are in the Pen Argyl. Approximately two-thirds of the wells are in valleys, one-fourth are on slopes, and only 5 percent are on uplands. Most of these wells, regardless of the geologic member in which they are drilled or their topographic position, are somewhat deeper than the non-H_2S-bearing wells in the same geologic unit or topographic position. Examination of the chemical analyses shows that in about half of the H_2S-bearing wells the water is dominantly a sodium bicarbonate water rather than the more common calcium magnesium bicarbonate type (Figures 4 and 5).

These data suggest that the sulfide-bearing water is derived from greater depths below land surface than the fresh water. The sodium-rich character of some of the H_2S-bearing water suggests that the rocks have not been completely flushed of the ions entrapped when the sediments were laid down. (See Poth, 1963, p. 80.)

In summary, the presence of hydrogen sulfide in these rocks is probably the

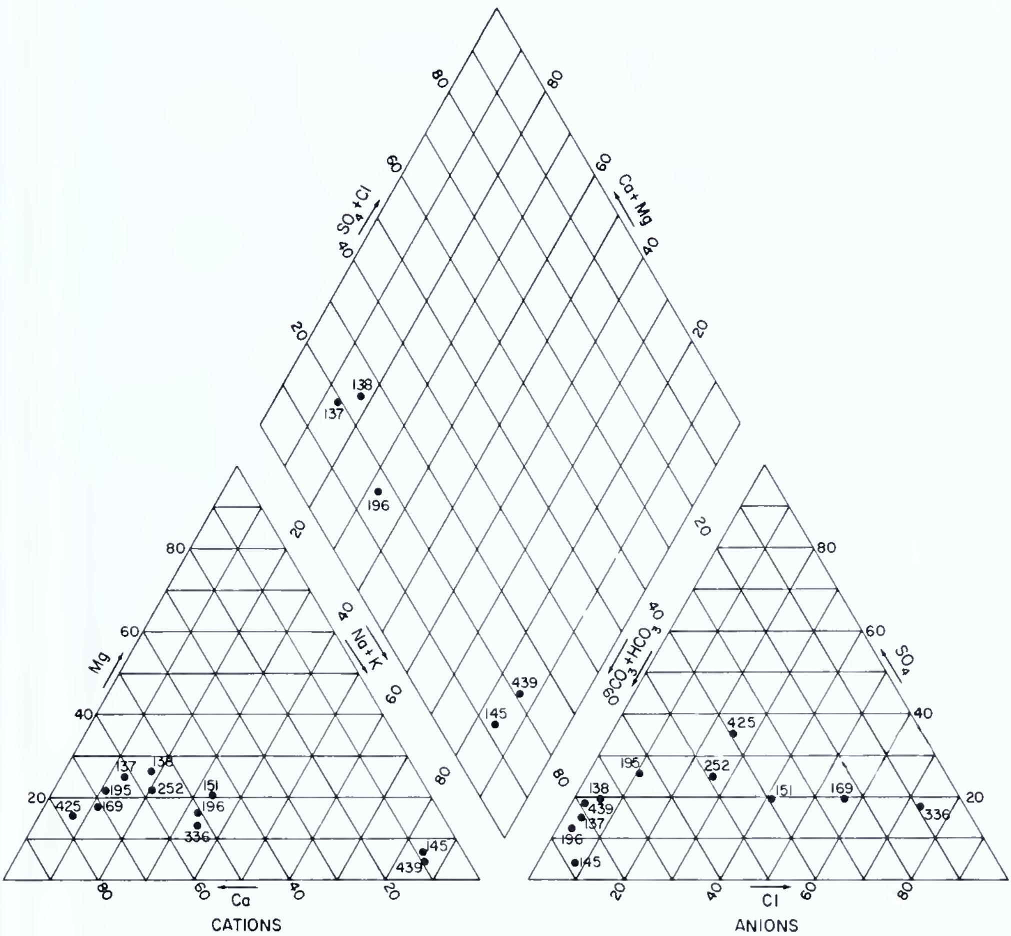

Figure 5. Chemical analyses of water in Northampton County. Numbers are those of wells sampled.

result of the following sequence of events. Water in the basin was marine or brackish and circulation of the water was restricted, so that reducing conditions obtained. In such an environment conditions were favorable for the reduction to sulfides of sulfates that were carried into the basin and to the subsequent precipitation of the sulfides. Decomposition of the sulfide minerals in the absence of oxygen produced hydrogen sulfide. Some of the hydrogen sulfide may have been produced directly from the sulfate reduction.

Following the induration of these sediments and their elevation above sea level, percolating fresh water began to flush the salt water. Flushing proceeded fastest near the surface, where the flow path of the water was the shortest. Chloride was readily removed, but the sodium and potassium were adsorbed on the clays of the Martinsburg and were released slowly by ion exchange with the calcium and magnesium in the fresh water. The slow anaerobic breakdown of the sulfide minerals released H_2S into the water.

Field Analyses

Approximately 550 determinations of hardness and specific conductance and 30 determinations of pH were made in the field. They are summarized in Table 5 and are listed with the other data on individual wells in Table 6.

Hardness in water is a measure of its resistance to sudsing and is due chiefly to the presence of calcium and magnesium ions. The field measurements of hardness are reported in grains per gallon (gpg) rather than in milligrams per liter (mg/l), because the field method is accurate only to plus or minus 1 grain per gallon; therefore, to state the results in milligrams per liter would imply a false accuracy. Hardness concentrations in milligrams per liter may be obtained by multiplying the grains per gallon by 17.

The median hardness is least in the Pen Argyl and increases slightly but progressively in the Ramseyburg and Bushkill Members. Topography apparently exerts little effect, although water in upland wells in Northampton County is harder than elsewhere in the area.

Plate 1 shows the distribution of hardness in the Martinsburg Formation. The water becomes harder along the south edge of the formation—especially in Northampton County where, locally, it may exceed 20 gpg. The increase is probably due to the presence of dolomite beds in the Bushkill Member. A few wells contain water of anomalously high or low hardness. The anomalies are probably due to contamination, to a deep source of water, or to the presence of local carbonate beds where the water is very hard, and to a local shallow source where the water is soft.

The specific conductance of water is a measure of the ability of a unit volume of water to conduct an electric current, and depends on the nature and concentration of ions in solution in the water. By knowing the relationship of the conductance to the ions in solution it is possible to predict the value of one

if the other is known. Field measurements of specific conductance, therefore, were compared mathematically with the dissolved-solids content of each of the 36 samples analyzed in the laboratory. In this way it was determined that the dissolved solids could be estimated by multiplying the conductance by 0.718 and subtracting 26 from the product. The standard error of estimate of this calculation is only 31 mg/l.

The field conductances support the conclusions drawn from the hardness data; that is, the water is progressively more mineralized from north to south, and the mineral content of the water is not related to the topographic position of the well.

The pH of the water is a measure of its acidity or alkalinity and is caused by the ions in solution. Only a few measurements were made of this property, but these indicate that the water is slightly acidic.

Table 5. *Summary of Field Analyses*

County	Type of well	Well position	Hardness: Number of wells	Hardness: Median (grains per gallon)[1]	Hardness: Range (grains per gallon)[1]	Specific conductance: Number of wells	Specific conductance: Median (micromhos at 25°C)	Specific conductance: Range (micromhos at 25°C)	pH: Number of wells	pH: Median	pH: Range
Lehigh	Bedrock domestic wells	Pen Argyl Member	31	4	1–11	31	200	<50–400	5	6.7	5.7–7.6
		Ramseyburg Member	76	5	1–10	76	230	75–460	3	7.1	6.9–7.6
		Bushkill Member	78	6	2–16	77	270	100–920	8	6.7	6.1–7.4
		Uplands	57	5	1–15	57	240	<50–920	3	7.0	7.0–7.1
		Slopes	72	5	1–16	72	255	<50–810	6	6.4	6.1–6.9
		Valleys	56	5	2–13	55	240	75–460	7	6.8	5.7–7.6
		Formation as a whole	185	5	1–16	185	240	<50–920	16	6.8	5.7–7.6
	Bedrock non-domestic wells	Pen Argyl Member	5	3	3–4	3	160	155–230	0		
		Ramseyburg Member	4	6	5–9	4	285	220–400	0	–	–
		Bushkill Member	25	6	1–11	25	310	140–460	1	8.25	8.25
		Uplands	4	8	4–10	4	312	195–460	0	–	–
		Slopes	15	5	1–9	13	230	160–360	0	–	–
		Valleys	15	7	3–11	15	310	140–450	1	8.25	8.25
		Formation as a whole	34	6	1–11	32	305	140–460	1	8.25	8.25
Northampton	Bedrock domestic wells	Pen Argyl Member	50	3	1–10	48	120	<50–420	0	–	–
		Ramseyburg Member	116	6	2–19	114	240	70–820	6	6.2	6.0–7.6
		Bushkill Member	134	8	2–24	135	300	85–1,300	7	7.0	6.5–7.7
		Uplands	45	9	2–24	45	300	100–1,300	3	6.6	6.0–6.6
		Slopes	191	6	1–24	189	245	<50–1,050	6	6.75	6.1–7.1
		Valleys	64	6	2–15	63	250	55–625	4	7.3	6.0–7.7
		Formation as a whole	300	7	1–24	297	250	<50–1,300	13	6.6	6.0–7.7
	Bedrock non-domestic wells	Pen Argyl Member	4	3	1–5	4	100	<50–260	0	–	–
		Ramseyburg Member	7	9	3–11	7	280	110–380	0	–	–
		Bushkill Member	7	10	5–23	7	380	250–1,000	0	–	–
		Uplands	2	11	10–12	2	385	370–400	0	–	–
		Slopes	8	4	1–23	8	132	<50–1,000	0	–	–
		Valleys	8	8	5–13	8	270	250–520	0	–	–
		Formation as a whole	18	8	1–23	18	270	<50–1,000		–	–
	Glacial deposits	Domestic wells	11	6	1–12	11	270	<50–315	0	–	–
		Non-domestic wells	3	9	1–9	3	280	50–295	1	6.6	6.6
		Combined	14	8	1–12	14	270	<50–315	1	6.6	6.6

[1]May be converted to milligrams per liter by multiplying by 17.

Table 6. *Record of Drilled Wells*

Location number: All wells are between 40°30′ and 41°00′ north latitude and 75°00′ and 76°00′ west longitude. The location number is the coordinates in minutes of the southeast corner of a 1-minute quadrangle within which the well is located.
Topographic setting: D, quarry; H, upland; S, slope; V, valley.
Aquifer: Qg, glacial sand and gravel: Qs, glacial sand; Omp, Martinsburg Formation, Pen Argyl Member; Omr, Martinsburg Formation, Ramseyburg Member; Omb, Martinsburg Formation, Bushkill Member.
Water level: F, flowing; +, above land surface.
Specific capacity: r, based on reported data; u, based on data obtained from 1-hour pumping test by U.S. Geological Survey personnel.
Use: C, commercial; H, domestic and/or stock; I, irrigation; N, industrial; P, public supply; R, recreational; T, institutional; U, unused.

Well No.	Location No.	Owner	Driller	Year drilled	Altitude above sea level (feet)	Well depth (feet)	Casing depth (feet)	Casing diameter (inches)	Depth to water-bearing zone (feet)	Topo. setting	Aquifer	Static water level: Depth below land surface (feet)	Static water level: Date measured	Reported yield (gpm)	Specific capacity (gpm per ft)	Use	Field analyses of water: Hardness (grains per gal.)	Field analyses of water: Specific conductance (micromhos at 25°C)	Remarks
							LEHIGH COUNTY												
Le- 56	3732	J.B. Bronstein	M.B. Biery	–	555	366	–	6	–	S	Omb	185	–	10	–	H	–	–	
180	3537	Lehigh Cement Co.	–	–	595	145	35	6	–	S	Omb	45	–	25	–	N	–	–	
181	3537	do.	–	–	605	543	–	8	–	S	Omb	90	July 1952	100	–	N	–	–	
182	3537	do.	Lehigh Cement Co.	–	580	350	–	8	–	S	Omb	–	–	35	–	N	8	360	
214	4138	Peters Foundry, Inc.	Wessner Bros.	1945	600	110	60	6	–	S	Omb	–	–	–	–	N	–	–	
215	4138	do.	do.	1945	600	85	30	6	–	S	Omb	16	Aug. 1945	–	–	N	–	–	
224	4538	Slatington Borough	–	1925	650	475	–	12	–	S	Omp	25	Sept. 1952	–	–	U	–	–	
225	4538	do.	–	1925	650	160	–	6	–	S	Omp	–	–	50	–	P	–	–	
233	3935	Trexler Orchards, Inc.	M.B. Biery	1925	640	275	65	6	–	H	Omb	200	1925	35	–	U	–	–	
234	3935	do.	do.	1947	650	242	58	8	–	H	Omb	–	June 1952	110	0.8r	N	–	–	
235	3836	do.	do.	1948	520	120	80	6	–	S	Omb	10	1948	20	–	N	–	–	
307	4440	Harold S. Hass	Siegfried and Kurtz	1953	595	78	–	6	–	S	Omp	10	Oct. 1953	20	–	U	–	–	
323	3634	J.J. Laudenslager	Harry Herman	1951	530	100	40	6	–	S	Omb	31	Nov. 1954	–	–	H	5	210	
329	3936	Roy Smoyer	Wessner Bros.	1952	670	169	30	5	–	H	Omb	26	Aug. 1952	8	–	H	–	–	
330	4036	Farm and Home Supply	–	1920	660	210	–	6	–	S	Omb	30	1948	–	–	H	14	810	
331	4036	United Church of Christ	Wessner Bros.	1952	715	150	40	6	–	H	Omb	50	Nov. 1954	15	–	H	8	310	
332	4136	A.D. Kern	Wessner Bros.	1953	685	156	40	6	–	S	Omb	40	Nov. 1953	–	–	H	15	550	
335	4337	Ralph A. Kern	do.	1945	795	93	30	6	–	V	Omr	43	Nov. 1954	–	–	H	4	185	
336	4131	Carl Gable	Kocher Bros.	1946	520	329	30	6	–	S	Omb	102	Apr. 1968	3	–	H	16	740	
340	4133	Raymond A. Roth	Harry Herman	1954	620	95	20	6	–	S	Omb	35	Nov. 1954	15	1. r	H	–	–	
341	4135	Claude Hoffman	Wessner Bros.	1940	690	135	–	6	–	S	Omb	–	–	–	–	H	7	320	
344	4231	Frank Kedl	Polzer	1951	385	95	25	6	–	S	Omb	–	–	–	–	H	–	–	
345	4332	Harold Moyer	Alio and Pugh	1951	430	129	45	6	80	S	Omr	–	–	–	–	H	5	217	

Le-347	4233	Herbert L. Mantz	Wessner Bros.	1944	592	84	30	6	–	H	Omr	30	–	30	–	H	–	–	
348	4235	David C. Semmel	do.	1934	595	140	30	6	–	S	Omp	25	–	–	–	H	6	290	
350	4035	Mrs. Steward Semmel	do.	1947	600	136	30	6	–	S	Omb	30	1947	–	–	H	8	345	
359	4239	Paul J. German	do.	1940	640	75	15	6	–	S	Omr	6	1940	–	–	H	7	283	
362	4539	Herman Semmel	E.C. Lenhart	1954	670	90	30	6	–	S	Omp	–	–	–	–	H	–	–	
365	4636	Keystone Lamp Mfg. Co.	M.B. Biery	1944	390	180	35	6	–	V	Omp	35	1944	85	–	N	–	–	
368	4438	Llewellyn Lloyd	Wessner Bros.	1950	485	120	20	6	–	S	Omp	–	–	–	–	H	–	–	
372	3639	R.H. Kressley	do.	1944	690	117	10	6	–	H	Omb	10	1944	–	–	C	–	–	
373	3740	Arthur Hassman	M.B. Biery	1938	500	97	20	6	80	S	Omb	20	1938	–	–	C	9	370	
374	3743	Zimmerman's Hotel	Wessner Bros.	1934	700	95	80	6	–	S	Omr	10	1934	–	–	C	–	–	
375	3844	Alton Snyder	do.	1949	610	75	20	6	–	V	Omr	4	1952	–	–	H	–	–	
378	3848	Allen Hamm	Wessner Bros.	1949	490	103	27	6	–	V	Omb	23	Nov. 1954	–	–	H	–	–	
380	3442	Austin Cobe	C.F. Wink	1953	730	137	130	6	–	S	Omb	–	–	–	–	H	–	–	
412	4035	Harold Ramaley	Wessner Bros.	1953	645	162	–	6	–	H	Omb	–	–	–	–	H	8	390	
413	4038	Monroe I. Peters	–	1890	520	42	6	6	–	V	Omb	16	1951	10	–	H	5	224	
414	4038	do.	–	1916	515	60	22	6	–	V	Omb	6	1954	–	–	U	–	–	
422	4144	Harold C. Rauch	Wessner Bros.	1934	590	85	45	6	85	V	Omr	3	Dec. 1954	–	–	C	–	–	
426	3950	Elwood Dotterer	do.	1946	460	105	12	6	–	V	Omp	–	–	–	–	C	–	–	
437	3746	Lee M. Oldt	Elwood Wessner	1953	790	113	26	6	–	H	Omb	31	Dec. 1954	5	–	H	–	–	
439	3635	Schantz Orchards	–	1939	585	280	30	6	–	S	Omb	25	Dec. 1954	8	–	N	–	–	
440	3635	do.	Wessner Bros.	1944	560	196	30	6	–	S	Omb	17	1944	–	–	N	–	–	
451	3541	E.P. Breininger	Harry Herman	1952	750	150	–	6	–	H	Omb	–	–	–	–	H	5	236	
475	4242	Philips Feed Service, Inc.	–	–	600	100	–	6	–	V	Omr	6	Dec. 1954	–	–	C	4	220	
489	4048	Carl B. Miller	R.F. Ruby	1955	565	80	–	6	–	S	Omp	–	–	–	–	H	11	315	
495	4638	Slatington Borough	C.D. Moyer	1957	850	501	194	8	95, plus others	S	Omp	50	1957	274	4.2u	P	3	160	
496	4638	do.	do.	1960	850	710	177	10	260,650,675-710	S	Omp	60	Mar. 1960	374	3.r	U	3	–	
497	4638	do.	do.	1963	860	662	111	10	184,537, 637	S	Omp	80	Feb. 1963	250	3.r	P	3		
498	4537	do.	do.	1966	540	200	56	12	72,168,192	S	Omp	13	May 1967	187	1.r	P	–	–	
526	4232	Clear Vue Acres	Robert Kocher	1968	610	503	31	8	–	S	Omb	31	Jan. 1968	13	.03r	P	–	–	
580	3737	Allentown Boys Club	R.H. Odenheimer Co.	1963	435	175	80	6	169	S	Omb	–	May 1963	35	–	U	–	–	
582	3442	Esso Gas Station	do.	1962	715	150	26	6	105,137	H	Omb	45	Dec. 1962	7	–	C	6	240	
616	4036	Gulf Oil Corp.	do.	1960	680	315	22	6	49	H	Omb	28	Mar. 1967	1	–	C	15	920	
628	3836	Apple Hill Co.	R.H. Odenheimer Co.	1959	385	315	19	6	300	V	Omb	100	Aug. 1959	3	–	U	–	–	
629	3835	Donald B. Reitz	do.	1959	595	198	125	6	190	S	Omb	120	Aug. 1959	8	–	H	3	160	
638	3732	Jaindl's Turkey Farm	do.	1959	580	205	47	6	65,165,201	H	Omb	35	Apr. 1959	60	–	H	5	230	
639	4146	Pa. Dept. of Highways	do.	1959	645	140	90	6	135	V	Omp	–	Mar. 1959	12	–	H	5	310	
657	3734	Allen Products Co., Inc.	do.	1957	440	263	53	8	260	S	Omb	130	Nov. 1957	150	–	N	–	–	
670	4036	Gulf Oil Corp.	do.	1957	680	405	43	6	70,282	H	Omb	28	Dec. 1956	4	–	C	–	–	
697	4538	Pa. Turnpike Commission	C.D. Moyer	1956	710	300	–	8	–	S	Omp	–	–	–	–	H	17	1,300	Salt from storage piles gets into well

Table 6. *(Continued)*

Well No.	Location No.	Owner	Driller	Year drilled	Altitude above sea level (feet)	Well depth (feet)	Casing depth (feet)	Casing diameter (inches)	Depth to water-bearing zone (feet)	Topo. setting	Aquifer	Static water level: Depth below land surface (feet)	Static water level: Date measured	Reported yield (gpm)	Specific capacity (gpm per ft)	Use	Field analyses of water: Hardness (grains per gal.)	Field analyses of water: Specific conductance (micromhos at 25°C)	Remarks
Le-700	3734	Allen Products Co., Inc.	do.	1964	430	501	–	6	–	H	Omb	105	Oct. 1964	16	.04r	U	–	–	
701	3634	do.	do.	1965	420	386	68	10	–	V	Omb	176	Mar. 1967	230	8.r	N	5	380	
703	4236	Albert Baer	do.	1965	700	303	21	8	145,298	V	Omr	–	Apr. 1965	28	–	I	–	–	
704	4236	do.	do.	1965	685	216	41	8	50 170,210	V	Omr	+3	May 1967	18	.2r	I	9	400	H_2S odor
722	3836	Trexler Orchards, Inc.	C.F. Wink	1967	410	700	20	8	90,180,220,350,660	V	Omb	3	Mar. 1967	9	1.0u	U	5	290	pH 8.2
723	3836	do.	do.	1967	385	400	24	8	155	V	Omb	0	Mar. 1967	15	.09u	U	3	210	H_2S odor
724	3935	do.	M.B. Biery	–	640	700	–	6	–	H	Omb	–	–	15	–	U	–	–	
725	3835	do.	Harry Herman	1958	605	260	74	6	–	S	Omb	82	Aug. 1962	40	.6r	C	–	–	
726	3836	do.	do.	1958	525	250	21	6	–	V	Omb	8	1958	12	.6r	N	9	–	
727	3835	Shellhammer Trailer Sales	–	1947	475	400	–	–	–	S	Omb	–	–	14	–	P	5	210	
781	3935	Herman Handwerk	Robert Kocher	1966	500	179	84	8	Between 81-120	S	Omb	13	July 1967	110	1.r	I	9	325	
812	3635	Jordan Lutheran Church	–	1960	450	282	–	6	–	S	Omb	–	–	–	–	H	13	460	
815	3443	Paul Fritz	C.F. Wink	1957	585	220	40	6	–	V	Omb	–	–	8	–	H	6	275	pH 7.4
816	4144	Atlantic Refining Co.	Wessner Bros.	1956	757	185	–	6	100.180	V	Omr	1	May 1967	–	–	C	5	245	pH 7.6
817	4045	Mrs. E. Hemmerly	Harry Herman	1961	605	130	27	6	–	S	Omp	25	May 1967	–	–	H	7	380	pH 5.7
818	3738	Harry Olaynick	Harry Todd	1959	670	203	20	6	55,74	S	Omb	20	May 1967	–	–	H	9	480	pH 6.1
822	4136	Neffs Lutheran Church	Wessner Bros.	1948	715	151	–	6	–	S	Omb	34	Apr. 1964	–	–	H	6	240	pH 6.2
824	4045	New Tripoli Bank	Russell Pugh	1967	600	203	45	6	120,160,190	S	Omp	27	May 1967	30	.68u	C	9	400	pH 6.7
825	4045	New Tripoli Fire Co.	Wessner Bros.	1955	550	98	–	6	–	V	Omp	17	July 1966	–	–	R	4	180	pH 6.8
826	4144	Grimms Mobile Homes	C.F. Wink	1959	590	62	42	6	55	V	Omr	5	May 1959	22	–	P	–	–	H_2S odor
828	4041	Jordan Inn	–	1929	565	100	–	6	–	V	Omp	–	–	–	–	C	8	290	pH 6.2
831	4048	Lynnport Comm. Fire Co. 1	E. C. Lenhart	1965	490	103	17	6	–	V	Omp	10	Mar. 1965	15	–	C	6	320	pH 7.6
842	4331	Brader Woodcraft	Rapp	1955	380	90	18	6	–	S	Omb	12	Sept. 1955	10	–	H	–	–	
843	4331	Keystone Mobile Homes	Kocher	1966	415	–	–	6	–	S	Omb	–	–	–	–	P	6	320	
844	4440	H.P. Balliet	Grube	1955	635	99	45	6	85-99	S	Omp	31	June 1967	22	–	H	4	220	
904	3733	Morris Wisser	Claude Otter	1965	450	213	80	6	–	S	Omb	54	Aug. 1967	50	–	P	4	190	
905	3732	Donald Schiffer	R.H. Odenheimer Co.	1967	440	150	50	6	80,144	S	Omb	54	Aug. 1967	35	–	H	–	–	
940	3338	William Gardner	–	1960	515	85	–	6	–	S	Omb	6	Sept. 1967	–	–	H	6	330	
956	4143	Ernest Ringer	Kohl Bros. Myerstown	1965	690	200	24	6	60,123	S	Omp	2	Oct. 1967	70	–	I	–	–	
957	4143	do.	do.	1965	693	160	44	8	100,138	S	Omp	22	June 1965	200	–	I	–	–	
977	4232	Clear Vue Acres	Robert Kocher	1967	623	625	21	8	10,45,466	H	Omb	45	Nov. 1967	7	.01r	P	–	–	

1001	4135	Stanley Ringer	do.	1965	650	380	31	6	36, plus other	S	Omb	21	June 1965	20	.09r	I	–	–	
1002	4037	George Marshal	Robert Kocher	1965	680	195	38	6	–	H	Omb	40	–	20	0.2r	H	–	–	
1003	3637	Martin Bennicoff	R.H. Odenheimer Co.	1966	470	227	15	6	90,200	S	Omb	75	Mar. 1966	4	–	H	–	–	
1005	3639	Marvin Fries	do.	1965	640	125	22	6	80,110	S	Omb	45	July 1965	10	1.2u	H	5	310	pH 6.5
1006	3441	R.P. Stoudt	do.	1965	755	396	57	6	160,215,320,390	H	Omb	85	Apr. 1965	15	–	H	9	280	pH 7.0
1007	3644	St. Pauls Union Church	do.	1965	810	225	23	6	80,160	H	Omr	50	June 1965	2	–	H	5	205	
1008	4039	Robert Sulzer	do.	1965	815	227	27	6	80,140,215	H	Omr	119	June 1965	6	–	H	6	240	pH 7.1
1009	4141	Henry E. Wotring	do.	1965	575	297	21	6	155,170,290	V	Omr	20	June 1965	10	–	H	–	–	
1010	4037	Douglas Rowland	do.	1965	700	127	25	6	102,120	H	Omb	25	Oct. 1965	12	–	H	–	–	
1011	4036	Norwood Kern	do.	1965	695	184	23	6	50,170	H	Omb	45	Apr. 1966	10	–	H	–	–	
1012	3441	Robert Bendus	do.	1965	750	175	40	6	115,165	H	Omb	88	May 1965	3	–	H	6	215	pH 7.0
1013	4233	Ronald Fritzinger	do.	1966	550	250	22	6	85,125	S	Omb	100	Apr. 1966	3	–	H	–	–	
1016	3835	Anthony Shay	do.	1966	585	227	113	6	122	S	Omb	–	–	3	–	H	–	–	
1017	3735	K.P.Steinmetz	do.	1965	400	125	23	6	65,82,112	S	Omb	78	July 1965	15	–	H	6	250	pH 6.9
1019	3634	Joseph Miller, Jr.	do.	1966	515	280	84	6	165,270	S	Omb	53	Apr. 1966	15	–	H	6	225	
1021	3835	Larry Higgins	do.	1965	550	200	30	6	148,160,175,185	H	Omb	20	June 1965	50	–	H	9	305	
1022	4038	Charles Smith	do.	1965	720	690	282	6	282,688	H	Omr	50	Aug. 1965	8	–	H	10	395	
1023	3742	John Kuzma	do.	1965	550	100	23	6	60,90,98	V	Omr	5	July 1965	35	–	H	4	160	
1024	3635	Arthur R. Miller	Homer Herman	1957	595	225	–	6	75, plus others	H	Omb	–	–	10	–	H	7	330	
1025	4439	Penn Big Bed Slate Co.	C.D. Moyer	1964	535	344	2	8	180,310	D	Omp	195	Apr. 1967	21	–	U	11	500	
1026	4439	Penn Big Bed Slate Co.	C.D. Moyer	1964	535	240	2	12	180,310	D	Omp	195	Apr. 1967	–	–	U	11	500	
1027	3738	George Werley	Homer Herman	1967	695	250	15	6	85	H	Omb	30	Apr. 1967	6	.06u	H	5	280	
1028	3737	Charles Kistler	do.	1962	700	527	10	6	–	H	Omb	50	July 1966	3	.01r	H		–	
1029	3739	Howard Raber	do.	1965	610	200	10	8	75	V	Omb	22	Apr. 1967	19	.78u	I	7	325	
1030	3739	do.	do.	1965	620	200	30	6	–	V	Omb	17	May 1967	26	1.0u	I	7	300	
1031	3737	Allentown Boys Club	do.	1957	450	223	–	6	–	S	Omb	29	Apr. 1967	2	.04u	U	4	165	
1032	3737	do.	do.	1957	400	220	40	6	–	S	Omb	25	1957	10	–	H	6	275	
1033	3737	do.	–	1955	412	240	40	6	130	S	Omb	18	Mar. 1967	2	.06u	U	5	220	
1034	3737	do.	Homer Herman	1965	585	225	60	6	50,105	S	Omb	75	Apr. 1967	30	–	T	–	–	
1035	3634	Lawrence Hower	do.	1964	455	115	4	6	90	S	Omb	18	May 1967	13	1.0u	H	5	210	
1037	4436	Kenman Water Co.	C D. Moyer	1958	560	410	70	10	375-400	H	Omr	83	May 1967	75	–	P	5	220	
1038	4436	Kenneth Christman	Russell Pugh	1951	565	110	15	6	90	H	Omr	63	May 1967	20	–	H	1	240	
1039	3733	Ernest Reinert	Forrest Reinert	1955	465	80	45	6	75	S	Omb	55	May 1967	3	–	H	–	–	
1040	3733	do.	Ernest Reinert	1961	465	95	18	6	–	S	Omb	40	June 1961	10	–	H	6	220	
1041	3636	Dennis E. Gehman	Homer Herman	1963	545	187	100	6	117,180	S	Omb	5	Aug. 1963	25	.6r	H	9	350	
1042	3636	Leonard Haring	Claude Otter	1960	645	210	41	6	70	H	Omb	44	July 1960	10	.08r	H	7	280	
1043	3637	Warren Hertzog	Kemmerer	1948	550	300	12	6	50	S	Omb	2	1948	10	.2r	H	6	240	
1044	4236	Albert Baer	C.D. Moyer	1955	690	100	21	6	–	V	Omr	+2	1955	12	–	H	10	370	H_2S odor
1045	3637	Mrs. Robert McNamara	Homer Herman	–	400	185	40	6	–	V	Omb	–	–	15	–	U	7	–	H_2S odor

Table 6. *(Continued)*

Well No.	Location No.	Owner	Driller	Year drilled	Altitude above sea level (feet)	Well depth (feet)	Casing depth (feet)	Casing diameter (inches)	Depth to water-bearing zone (feet)	Topo. setting	Aquifer	Static water level: Depth below land surface (feet)	Static water level: Date measured	Reported yield (gpm)	Specific capacity (gpm per ft)	Use	Field analyses of water: Hardness (grains per gal.)	Field analyses of water: Specific conductance (micromhos at 25°C)	Remarks
Le-1046	3735	R.M. Drexinger	do.	1963	385	150	70	6	–	S	Omb	–	–	–	–	H	5	220	
1047	3637	Franklin L. Geho	Harry Todd	1961	635	432	31	6	90,270	S	Omb	37	May 1967	3	.01r	H	8	340	
1048	3638	R.E. Billard	Elwood Wessner	1948	610	116	15	6	90,115	S	Omb	10	May 1967	10	0.8r	H	8	350	
1049	3638	Mohrs Orchards, Inc.	–	–	495	52	–	6	–	S	Omb	20	May 1967	10	–	H	7	310	
1050	3442	American Oil Co.	Homer Herman	1967	685	190	40	6	–	S	Omb	30	May 1967	13	8.6u	C	3	135	pH 6.4
1051	3942	North End Rod & Gun Club	do.	1966	700	145	20	6	–	S	Omr	30	May 1967	11	.85u	H	5	265	pH 6.9
1052	3538	Paul Prosky	Forrest Reinert	–	645	105	–	6	–	H	Omb	60	June 1967	4	.18u	H	2	105	
1053	3539	Cryo-Therm Corp.	C.F. Wink	1958	640	430	40	6	–	H	Omb	–		–	–	H	12	460	
1054	3635	Schantz Orchards, Inc.	Wessner	1939	545	195	20	6	–	V	Omb	–		20	–	C	–	–	
1055	3635	do.	Claude Otter	1962	530	250	20	8	28, plus others	V	Omb	3	June 1967	35	–	I	7	310	
1056	3635	do.	Elwood Wessner	–	530	105	20	6	–	S	Omb	13	June 1967	7	.38u	H	7	300	
1057	3636	do.	Schantz Orchards, Inc.	1967	500	310	16	8	20,90,120 150,176,240	V	Omb	6	June 1967	18	.33u	I	8	300	
1058	3635	do.	Elwood Wessner	1957	600	200	15	6	–	S	Omb	33	June 1967	8	1.2u	H	6	280	
1059	3538	Roy E. Werley	Harry Herman	1952	620	161	20	6	–	H	Omb	–	–	–	–	H	13	535	
1060	3540	Nevin Fry	Elwood Wessner	1956	740	128	7	6	–	S	Omb	–	–	15	–	H	8	320	
1061	3440	Elmer Morgan	Jay Kemera	1966	570	116	20	6	–	V	Omb	8	July 1967	10	.25u	H	5	240	H_2S odor
1062	3441	Lehigh Valley Electron. Co.	R.H. Odenheimer Co.	1961	715	207	–	6	130	H	Omb	38	July 1967	35	–	N	4	195	
1063	3440	Commadore Yorgey	–	1951	675	145	90	6	–	H	Omb	30	June 1951	30	–	H	5	250	
1064	3340	Woodrow Samuels	–	1925	550	185	–	6	–	S	Omb	36	July 1967	8	–	H	7	280	
1065	3339	Earl W. Scherer	Elwood Wessner	1947	650	179	–	6	–	H	Omb	–	–	20	–	H	4	205	
1066	3935	Roy Rice	Louis Schantz	1967	530	68	18	6	–	V	Omb	2	July 1967	12	1.7u	C	7	330	
1067	3936	Donald Heinly	Henry Kocher	1967	675	220	60	6	70,212	H	Omb	59	July 1967	25	.65u	H	4	310	H_2S odor
1068	3838	Carl Heinly	do.	1963	430	110	22	6	–	V	Omb	7	Oct. 1963	10	–	H	6	245	H_2S odor
1069	3638	Peter Reith	Ted Rothrock	1967	680	172	21	6	75,160	H	Omb	56	July 1967	25	4r	H	–	–	
1070	3638	Moyer Construction Co.	J.M. Mayer	1967	605	300	36	6	250	H	Omb	–	–	3	.06u	H	–	–	
1071	3639	Bernard Tognoli	Homer Herman	1927	675	98	40	6	–	H	Omb	35	July 1967	20	1.9u	H	4	195	
1072	3639	Chester Yeakel	Ted Rothrock	1957	645	500	2	8	–	S	Omb	52	July 1967	1	.03u	U	7	270	
1073	3540	Ralph Zettlemoyer	–	–	635	50	15	6	–	V	Omb	16	July 1967	20	–	H	6	240	
1074	3639	Chester Yeakel	Ted Rothrock	1957	640	265	6	6	–	S	Omb	218	July 1967	1	–	H	7	270	
1075	3443	John F. Stettler, Jr.	Clarence Wink	1963	620	100	45	6	60, plus other	V	Omb	15	April 1968	32	–	I	4	140	

1087	3736	John A. Johnston	Homer Herman	1965	370	155	25	8	–	V	Omb	–	–	200+	–	N	6	330	
1088	3736	do.	Harry Herman	1958	370	120	25	6	–	V	Omb	30	Apr. 1968	200	–	N	–	–	
1089	3736	do.	Kohl Bros. Myerstown	1956	620	600	28	12	–	S	Omb	42	Apr. 1956	37	–	U	–	–	
1091	4035	do.	H. Herman	1962	529	196	–	6	–	V	Omb	–	–	47	–	U	–	–	
1092	4036	do.	Homer Herman	1965	673	300	–	6	–	V	Omb	4	May 1968	36	–	I	–	–	
1093	3936	Stahley Landscape Service	Kocher	1960	690	150	–	8	–	H	Omb	46	May 1968	40+	–	I	10	405	
1094	4135	Stanley R. Ringer	H. Herman	1956	640	222	22	6	–	V	Omb	0	May 1968	10	–	U	–	–	
1095	4135	do.	Harry Todd	1960	658	422	23	8	–	V	Omb	6	May 1968	20	–	I	–	–	
1096	4135	do.	Wessner	1929	656	99	8	6	–	V	Omb	–	–	20	–	S	11	450	
1097	4135	Reuben H.W. Ringer	Homer Herman	1966	640	130	–	6	–	V	Omb	3	May 1968	50+	–	I	8	355	
1098	4135	do.	Wessner	1960	645	67	–	6	–	V	Omb	–	–	30	–	U	–	–	
1099	4134	Calvin C. Geiger	Robert Kocher	1966	620	180	–	6	44,85,125	V	Omb	+1	May 1968	50	6r	I	8	370	
1100	4441	Earl M. Zellner	Robert Itterly	1964	660	195	16	6	–	V	Omp	8	May 1968	100+		I	3	155	
1101	4043	Raymond C. Snyder	Wessner	1948	660	150	–	6	–	V	Omr	–	–	55		I	–	–	
1102	4142	do.	Harry Herman	1950	677	397	–	8	–	V	Omr	F	May 1968	105	–	I	–	–	
1103	4143	do.	do.	1956	708	380	–	8	–	V	Omr	F	May 1968	80	–	I	7	310	
1104	4240	Orrin H. Fink	Kohl Bros. Myerstown	1966	660	200	23	6	86	V	Omr	7	May 1968	12	–	I	–	–	H_2S odor
1105	4240	do.	do.	1966	647	400	50	6	102	V	Omr	4	May 1968	10	.03r	I	–	–	
1106	3936	Lehigh Co. Comm. Coll.	do.	1968	620	600	62	8	43,75,95,457-485, 520-580	S	Omb	22	May 1968	30	1.4u	T	8	320	H_2S odor; would not clear
1120	4539	Thomas Yezik	Charles Moyer	1959	695	118	80	6	38 plus other	S	Omp	F	June 1968	35	–	H	1	<50	
1121	4540	Douglas Farber	Russell Pugh	1967	740	129	56	6	18,72,87,123	S	Omp	30	May 1967	15	.2r	H	4	165	
1122	4540	Clarence Knettle	Harry Todd	1962	690	108	74	6	74	H	Omp	60	Aug. 1962	20	–	H	1	<50	
1123	4541	Vincent DeSanctis	Russell Pugh	1966	670	97	24	6	38,86	S	Omp	5	Oct.1966	15	.9r	H	4	190	H_2S odor
1124	4333	John Horwith, Jr.	do.	1966	360	218	20	6	68,96,213	V	Omr	55	July 1966	12	.08r	H	9	380	H_2S odor
1125	4334	Russell Parry	–	1965	500	120	30	6	85	V	Omr	–	–	–	–	H	7	280	
1126	4335	William A. Zellner	Clarence Wink	1949	930	285	60	6	96 plus other	S	Omr	60	–	10	–	H	5	210	
1127	4335	Donavon R. Bauer	Russell Pugh	1964	550	143	22	6	36	V	Omr	30	Oct. 1964	8	.08r	H	4	160	
1128	4336	Elden Werley	Homer Herman	1964	780	53	49	6	–	S	Omr	29	1964	11	–	H	4	220	
1129	4236	William Shupp	–	1950	775	65	35	6	–	S	Omr	5	–	–	–	H	4	210	
1130	4233	Robert Soldridge	Harry Todd	1961	625	120	30	6	110	S	Omr	20	Sept. 1961	12	–	H	5	280	
1131	4034	Warren Wagner	R.H. Odenheimer Co.	1963	590	312	17	6	300	S	Omb	150	Aug. 1963	–	–	H	5	260	
1132	4034	do,	do.	1967	585	152	40	6	60	S	Omb	50	Sept. 1967	5	–	H	5	250	
1133	4233	August Ballas	R.h. Odenheimer Co.	1967	610	152	20	6	90,146	V	Omb	15	June 1967	10	–	H	–	–	
1134	4232	Ronald Cleaver	do.	1966	630	200	35	6	75	H	Omb	50	July 1966	3	–	H	7	330	
1135	4135	Richard Roberts	Robert Kocher	1966	692	153	44	6	68,80,148	H	Omb	45	Oct. 1966	30	.5r	H	8	420	
1136	4034	Earl Nuss	Harry Todd	1967	565	168	14	6	149,155,168	S	Omb	85	Mar. 1967	20	1.r	H	–	–	
1137	4134	Calvin C, Geiger	Henry Kocher	1966	700	301	–	6	204, plus other	H	Omr	45	Sept. 1966	6	.02r	H	5	270	
1138	4540	William Kistler	Russell Pugh	1966	650	150	90	6	130, 139, 145	S	Omp	8	June 1966	15	–	H	–	–	
1139	4539	Charles Eaches	R.H. Odenheimer Co.	1966	625	102	70	6	75,82,95	S	Omp	37	Aug. 1966	15	–	H	–	–	

Table 6. *(Continued)*

Well No.	Location No.	Owner	Driller	Year drilled	Altitude above sea level (feet)	Well depth (feet)	Casing depth (feet)	Casing diameter (inches)	Depth to water-bearing zone (feet)	Topo. setting	Aquifer	Static water level: Depth below land surface (feet)	Static water level: Date measured	Reported yield (gpm)	Specific capacity (gpm per ft)	Use	Field analyses of water: Hardness (grains per gal.)	Field analyses of water: Specific conductance (micromhos at 25°C)	Remarks
Le-1140	4438	Lamont Kern	Russell Pugh	1966	600	150	103	6	115,150	H	Omp	55	May 1966	15	–	H	3	130	
1141	4438	David Bilheimer	do.	1967	605	164	28	6	140,150,160	H	Omp	100	Apr. 1967	15	–	H	4	190	
1142	4438	Kenneth Weaver	do.	1967	630	165	70	6	82,144,161	H	Omp	85	July 1967	15	1.r	H	–	–	
1143	4439	Donald Bauer	do.	1966	560	87	22	6	52	S	Omp	15	July 1966	15	–	H	–	–	
1144	4438	Robert Lewis	do.	1966	485	137	30	6	130	S	Omp	30	July 1966	15	.2r	H	5	225	
1145	4438	Donald Scheirer	do.	1966	660	215	72	6	112,172	S	Omr	80	Aug. 1966	8	.06r	H	5	230	
1146	4437	Roger Williams	do.	1966	780	385	75	6	181,320	S	Omr	100	Aug. 1966	2	.01r	U	–	–	
1147	4033	Earl Nuss	Harry Todd	1968	650	540	44	8	45,72,93,151,200,493	H	Omb	40	June 1968	7	.04r	P	10	460	
1148	4342	Warren Bittner	Russell Pugh	1965	660	265	20	6	35,75	S	Omp	17	1966	45	–	I	4	230	
1149	4342	do.	do.	1966	695	95	32	6	46,78,89	H	Omp	22	Sept. 1966	15	.4r	H	–	–	
1150	4338	Norman Peters	do.	1966	615	76	47	6	68	V	Omr	2	July 1968	15	.5r	H	–	–	H_2S
1151	4237	Abraham Ahner	do.	1967	810	134	82	6	90,110	H	Omr	45	Oct. 1967	15	.2r	H	–	–	
1152	4441	William Fillman	Franklin & W. Reith	1966	670	80	29	6	36,57,75	S	Omp	16	Oct. 1966	14	.4r	H	3	140	
1153	4441	Albert Gabowitz	Franklin & W. Reith	1966	735	84	30	6	65,74	H	Omp	38	Sept. 1966	14	4.r	H	4	180	
1154	4241	Harold J. Rex	Raymond Werner	1967	695	120	63	6	75,114	H	Omr	33	July 1967	15	.2r	H	5	260	
1155	4040	James Shmoyer	Robert Kocher	1966	670	150	22	6	35,54,135	S	Omr	12	Oct. 1966	12	1.r	H	5	240	
1156	4139	Franklin Fetherolf	E.C. Lenhart	1968	645	185	41	6	81,102,150-155	H	Omr	35	May 1968	8	.08r	H	3	160	
1157	4039	John Washinski	R.H. Odenheimer Co.	1967	800	327	20	6	100,315	H	Omr	100	Feb. 1967	8	–	H	5	245	
1158	4039	Richard R. Kohrs	Robert Kocher	1966	800	154	25	6	78,114,154	H	Omr	80	July 1966	10	.1	H	–	–	
1159	4039	LeRoy Christine	do.	1967	750	154	20	6	–	S	Omr	55	May 1967	25	1.r	H	5	230	
1160	4442	Clarence J. Rex	do.	1965	700	120	30	6	–	S	Omp	14	July 1965	20	.4r	H	3	155	
1161	4442	Paul H. Bittner	E.C. Lenhart	1965	720	120	44	6	37,53,108	S	Omp	20	Dec. 1965	31	3.r	H	6	260	
1162	3843	George M. Fahey	do.	1967	750	174	26	6	63,106,107	H	Omr	35	Nov. 1967	11	.4r	H	5	230	
1163	3842	Arlan Bittner	do.	1967	670	81	20	6	20,35,80	V	Omr	5	Nov. 1967	17	2.r	H	2	130	
1164	4044	Wardell F. Steigerwalt	do.	1966	650	101	63	6	55,73,101	S	Omp	25	June 1966	18	.9r	H	4	180	
1165	3842	Mrs. Gilbert Ressler	R.H. Odenheimer Co.	1967	745	202	23	6	78,197	H	Omr	68	Apr. 1967	4	.03r	H	3	150	
1166	3640	Kenneth Morton	E.C. Lenhart	1968	720	181	51	6	70,124,181	H	Omb	50	Apr. 1968	10	2.r	H	4	190	
1167	3742	Allen Ruhe	R.H. Odenheimer Co.	1968	650	77	22	6	50,60,74	V	Omr	10	Mar. 1968	25	–	H	4	190	
1168	4341	Elwood Handwerk	Russell Pugh	1968	665	110	42	6	95,105	V	Omr	20	June 1968	15	.7r	H	–	–	
1169	4438	Forrest Roth	do.	1968	510	100	45	6	89,95	V	Omr	15	June 1968	15	.9r	H	–	–	
1170	4147	Ralph Hamm	E.C. Lenhart	1967	640	105	25	6	30,88,105	H	Omp	17	June 1967	10	.14	H	–	–	

1171	4145	Vernon Bennighoff Estate	E.C. Lenhart	1966	570	93	47	6	40,74,93	S	Omp	25	Nov. 1966	15	.8r	H	4	180	
1172	4146	Charles Hager	Russell Pugh	1968	540	130	72	6	56,63,113,128	S	Omp	30	July 1968	15	.3r	H	–	–	
1173	4247	George Wertman	E.C. Lenhart	1966	685	76	31	6	24,46,76	H	Omp	10	July 1966	27	3.r	H	4	200	
1174	4048	George D. Billig	do.	1966	525	140	38	6	25,114,140	H	Omp	7	Aug. 1966	20	2.r	H	–	–	
1175	4048	Russell Dotterer	do.	1966	480	58	28	6	35,50	V	Omp	8	July 1966	8	.6r	H	–	–	
1176	4048	John J. Hemmerly	do.	1966	465	58	20	6	24,58	V	Omp	6	June 1966	7	.7r	H	4	200	
1177	4047	John Seidel	do.	1966	490	70	16	6	11,47,70	V	Omp	10	Aug. 1966	16	.8r	H	5	240	
1178	4044	Homer Snyder	Russell Pugh	1968	560	97	34	6	20,85	S	Omp	30	July 1968	10	.2r	H	–	–	
1179	4044	William Scheetz	R.H. Odenheimer Co.	1968	680	62	23	6	40,50,58	S	Omr	7	Apr. 1968	20	–	H	–		
1180	3950	Wilbur Heil	E.C. Lenhart	1966	470	109	31	6	62,87,109	S	Omr	35	Sept. 1966	15	.5r	H	7	380	
1181	4033	John Hawk	Harry Todd	1966	645	100	45	6	78,88	S	Omb	45	Oct. 1966	15	–	H	8	420	
1182	4339	Mrs. Mabel DeLong	Homer Herman	1968	640	87	–	6	–	S	Omr	37	Apr. 1968	–	–	H	5	260	
1183	4341	Clarence Harter	Raymond Werner	1965	710	184	54	6	120	S	Omr	22	Aug. 1965	30	–	H	5	220	
1184	4339	Ernest Heil	E.C. Lenhart	1960	570	69	56	6	27,42,68	V	Omr	15	July 1960	24	2.r	H	3	165	
1185	4139	Harold Rumble	Robert Kocher	1965	580	90	69	6	85	V	Omr	4	Sept. 1965	40	.7r	H	6	280	
1186	4139	Herman Fortkamp	do.	1968	725	336	20	8	43,282,310	S	Omr	54	July 1968	20	.08r	P	5	260	H_2S odor
1187	4243	Donald Rex	Charles Moyer	1968	715	130	60	6	70,75,126	S	Omr	5	Aug. 1968	10	.2r	H	–	–	
1188	4143	Paul Geroge	E.C. Lenhart	1968	650	97	48	6	27,46,97	H	Omr	15	July 1968	20	2.r	H	–	–	
1189	4242	Melvin Rex	Homer Herman	1968	605	75	30	6	–	V	Omr	5	Apr. 1968	25	–	H	4	200	
1190	4140	Frank Seagreaves	do.	1966	695	93	20	6	–	S	Omr	12	June 1966	20	–	H	4	210	
1191	4137	Carl Malkames	Herman	1961	695	87	20	6	87	H	Omb	–	–	9	–	H	8	380	
1192	4137	Ernest V. Geiger	Homer Herman	1963	640	140	40	6	–	S	Omb	18	Sept. 1962	20	–	H	2	100	
1193	4040	Willard Kistler	–	1941	725	100	–	6	–	S	Omr	30	Jan. 1965	6	.4r	H	4	270	
1194	4042	Merlin C. Peters	Harry Todd	1968	750	79	62	6	48,70	S	Omr	35	Sept. 1968	17	3.r	H	–	–	
1195	4043	Paul Peter	Homer Herman	1963	680	103	21	6	–	V	Omp	10	Nov. 1963	–	–	H	4	180	
1196	4041	Andrew Smerek	E.C. Lenhart	1965	540	62	23	6	10,46,65	V	Omr	10	Apr. 1965	10	1.r	C	5	240	
1197	3941	Richard Kocher	Charles Moyer	1962	650	178	18	6	77,161	S	Omr	60	Nov. 1962	13	–	H	3	165	
1198	3942	Ulrich Christen	Homer Herman	1964	680	75	14	6	–	V	Omr	9	May 1964	–	–	H	3	120	
1199	3943	James F. Bausch	Herman	1963	585	130	18	6	–	V	Omr	25	Dec. 1963	–	–	H	3	180	
1200	3944	Fred Zimmerman	–	1949	620	100	40	6	–	S	Omr	11	May 1949	–	–	H	6	310	
1201	3944	Curtis Werley	Kermit Snyder	1964	725	90	20	6	–	V	Omr	18	Nov. 1964	10	–	H	3	160	
1202	3844	Harold F. Rex	Wessner	1945	640	100	20	6	–	V	Omb	5	–	–	–	H	5	260	
1203	3744	Nevin Dietrich	R.H. Odenheimer Co.	1964	695	105	16	6	70,100	V	Omb	15	Nov. 1964	15	–	H	4	200	
1204	3940	C.L. Geist	Elwood Wessner	1951	725	100	6	6	50,80	S	Omr	30	May 1951	20	–	H	5	230	
1205	3940	Emory Peters	E.C. Lenhart	1960	630	200	20	6	180	V	Omr	14	Sept. 1968	5	–	H	–	–	H_2S odor
1206	3939	Penn. Game Commission	–	–	520	97	–	6	–	V	Omr	30	–	–	–	H	4	210	
1207	3937	Trexler Game Preserve	Wessner	1958	445	151	–	6	–	S	Omb	123	–	–	–	C	5	260	
1208	3837	do.	M.B. Biery	1935	480	505	–	6	–	H	Omr	–	–	–	–	C	5	240	
1209	3838	Quinten K. Hoffman	–	1943	448	90	20	6	–	V	Omr	2	–	–	–	S	5	300	

Table 6. *(Continued)*

Well No.	Location No.	Owner	Driller	Year drilled	Altitude above sea level (feet)	Well depth (feet)	Casing depth (feet)	Casing diameter (inches)	Depth to water-bearing zone (feet)	Topo. setting	Aquifer	Static water level: Depth below land surface (feet)	Static water level: Date measured	Reported yield (gpm)	Specific capacity (gpm per ft)	Use	Field analyses of water: Hardness (grains per gal.)	Field analyses of water: Specific conductance (micromhos at 25°C)	Remarks
Le-1210	3837	Robert W. Kiser	Homer Herman	1963	445	105	13	6	–	V	Omr	12	Aug. 1963	–	–	H	8	400	
1211	3839	Donald E. Hontz	do.	1957	630	298	–	6	–	H	Omr	–	–	–	–	H	8	460	
1212	3840	Paul H. Hausman	Herman	1958	450	105	10	6	<50	V	Omr	6	–	–	–	H	7	330	H_2S odor
1213	3841	Victor Kobordo	Harry Todd	1960	700	90	20	6	50,70	H	Omr	40	Sept. 1960	15	–	H	4	230	
1214	3741	Elmer Gressley	Joseph Kasmakites	1964	810	118	30	6	–	H	Omr	48	July 1964	8	–	H	3	135	
1215	3740	Harry S. Lichtenwalner	–	–	490	195	–	6	–	V	Omr	42	July 1965	–	–	H	4	240	
1216	3640	Forrest Barto	Homer Herman	1964	705	130	16	6	–	H	Omb	40	May 1964	–	–	H	3	185	
1217	3641	Edwin Trexler	E.C. Lenhart	1961	610	117	28	6	70,90,117	H	Omr	57	July 1961	20	1.r	H	4	220	
1218	3641	L.R. Chattin and Sons	do.	1961	570	125	35	6	58,101,124	S	Omr	35	Nov. 1961	17	.3r	H	7	200	
1219	3642	L.R. Chattin, Jr.	do.	1961	605	125	59	6	40,50,107,148	S	Omr	25	Nov. 1961	16	.2r	S	4	180	
1220	3541	Ralph C. Smith	Herman	1935	610	92	13	6	–	V	Omb	14	–	–	–	S	5	225	
1221	3542	Kermit Heintzelman	E.C. Lenhart	1957	725	204	22	6	50,150	H	Omb	45	May 1957	7	.04r	H	5	290	
1222	3542	Clarence Zimmerman	Homer Herman	1966	710	200	26	6	–	H	Omb	42	June 1966	–	–	H	8	480	
1223	3743	Stanley Kunkel	do.	1966	815	107	42	6	–	H	Omr	50	May 1966	–	–	H	3	140	
1224	3643	Kenneth Wisser	E.C. Lenhart	1960	765	220	70	6	60,141,218	H	Omb	45	Aug. 1960	17	.7r	H	4	240	
1225	3643	Earl Schrammel	R.H. Odenheimer Co.	1964	840	280	30	6	273	H	Omr	150	Dec. 1964	10	–	H	4	210	
1226	3444	John D. Shreve, Jr.	Herman	1958	610	215	–	6	50, plus other	S	Omr	–	–	–	–	H	5	275	
1227	3543	Charles J. Loch	Kermit Snyder	1954	610	114	40	6	20,80, plus 2 others	V	Omb	10	1968	40	–	S	3	170	
1228	3338	E.O. Shoemaker	Joseph Kasmakites	1965	640	110	–	6	80, plus other	H	Omb	–	–	10	–	H	5	230	
1229	3339	Bruce Shupp	Herman	1962	560	185	–	6	–	H	Omb	–	–	–	–	H	5	250	
1230	3239	William Bear	Claude Otter	1963	565	330	40	6	285,330	S	Omb	187	–	–	–	H	7	340	
1231	3342	Sigmund P. Lutterschmidt	Herman	1961	705	116	16	6	90-100	H	Omr	42	–	15	–	H	3	160	
1232	3543	Robert Hewitt	Homer Herman	1966	630	118	20	6	–	S	Omr	18	1966	–	–	H	4	170	
1233	3645	Earl Odenheimer	R. H. Odenheimer Co.	1963	830	120	21	6	102	S	Omr	20	May 1963	10	–	H	3	160	
1234	3645	Earl Shoemaker	Ted Rothrock	1965	820	90	–	6	–	V	Omr	–	–	–	–	H	2	75	
1235	3745	George Metzger	Wessner	1950	720	95	35	6	45,95	S	Omb	25	–	35	–	H	4	205	
1236	3646	Oliver Camp	do.	1953	630	107	–	6	–	V	Omb	10	–	–	–	H	4	160	
1237	3745	George E. Weida	Charles Moyer	1963	690	115	56	6	70,112	V	Omr	15	–	25	–	H	5	170	
1238	4045	Mrs. Lewis Kunkel	Harry Todd	1964	630	–	–	6	–	S	Omp	–	–	–	–	H	4	150	
1239	4046	Franklin Mengel	E.C. Lenhart	1968	510	57	22	6	7,42,57	V	Omr	7	July 1968	9	.3r	H	5	210	

Also, few traces were plotted parallel to the general northeast-southwest strike of bedding because of the possibility of mistaking bedding traces for fracture traces. Only the most conspicuous linear features were plotted. Care was taken to determine that the traces were not man-made features.

WATER-BEARING PROPERTIES OF THE FORMATION

Effect of Use

The use to which a well is put often determines the physical characteristics of the well. A well that is drilled for public supply, industrial, commercial, institution, or irrigation use will generally be deeper and yield more water (and so enable more full appraisal of the aquifer at that point) than a well drilled for domestic use. For this reason the wells inventoried during this investigation have been grouped in two categories. The nondomestic wells are as follows:

	Number of wells	
Use of well	Lehigh County	Northampton County
Public supply	17	34
Industrial	16	5
Commercial	0	5
Institution	6	1
Irrigation	30	1

Nondomestic wells are the best source of information about the aquifer, but they are scarce and are unevenly distributed. Therefore, information on domestic wells is used to supplement that from the nondomestic wells and to supply information on the water-bearing properties of the formation in areas where such information is otherwise lacking.

Data on well depth, casing depth, reported yield, and static water level are summarized in Table 1 by county, use, geologic member, and topographic position.

Well and Casing Depths

The median depth of domestic wells is about the same in each of the members in both counties, ranging from 102 to 120 feet, except in the Bushkill Member in Lehigh County where the median depth is 156 feet. A large number of the deeper wells in this unit are in upland areas where the median depth is 184 feet. The average nondomestic well is about twice as deep as the average domestic well.

The median depth of casing in domestic wells is about 30 feet in both counties. Nondomestic wells in Lehigh County have only a slightly greater median depth of casing (38 feet), but those in Northampton County contain about three times as much casing.

The topographic position of the well has a slight effect on the depth to which

the well is drilled. Wells on uplands average 30 to 40 feet deeper than those on slopes and are deeper in Lehigh County than in Northampton County. Wells in valleys tend to be somewhat shallower than those on slopes, but the difference in depth is much smaller than between wells on uplands and on slopes.

Topography exerts only a slight and inconsistent effect on the lengths of casing required in domestic wells. However, nondomestic wells on uplands and slopes contain about twice as much casing as they do in valleys. Furthermore, these wells contain about twice as much casing in Northampton County as they do in Lehigh County in the corresponding topographic position.

Water-Bearing Zones

Most wells in the Martinsburg obtain water from several discrete openings separated from one another by nonyielding or barren zones. Table 2 summarizes the data available on water-bearing zones. The table contains a variety of information.

First, as the denominator of the fraction indicates the number of wells penetrating any particular depth range, the denominator of the shallowest range obviously indicates the total number of wells in that unit for which data on depth to water-bearing zones were obtained. Thus, data were obtained from 72 wells in the Ramseyburg Member in Lehigh County.

Second, the table indicates the maximum depth range of the wells and yielding zones for which data were obtained. For example, in Northampton County two wells on slopes reach the 751- to 800-foot depth range and one of these is 1,030 feet deep. However, only a single yielding zone was encountered below 400 feet and that was in the 751- to 800-foot range.

Third, the relative abundance of zones at different depths is shown by the value of the fraction. However, abundance ratios become less sensitive as the depth increases, because the size of the sample decreases.

Most of the wells yield water from two or three zones and a few obtain water from as many as six openings. Yielding zones are most abundant in the Martinsburg in the 50- to 150-foot depth range; however, they are sufficiently abundant to about 400 feet below land surface to make drilling to this depth worthwhile where maximum well yields are needed. There are generally not enough water-bearing zones below 400 feet to justify the added expense of drilling below that depth. However, data on water-bearing zones at depths greater than 300 feet beneath valleys are not sufficiently abundant for evaluation, because wells in valleys are shallower than those in other topographic positions. Lehigh County wells provide more information on the deeper zones than do the Northampton County wells because of the greater abundance of deep wells in Lehigh County. The topographic position of a well does not appear to be important in determining either the depth or frequency of occurrence of water-bearing zones.

The effect of multiple water-bearing zones on the yield of the well appears to be surprisingly slight. Figure 2 shows the median yield of wells in the Martinsburg in the two counties classified according to the number of water-bearing

1240	4046	Albert W. Leach	do.	1968	520	105	33	6	48,60,104	S	Omr	7	July 1968	5	.09r	H	2	320	Cement filled below
1241	3847	David C. Diehl	do.	1961	520	104	41	6	53,86,104	S	Omr	10	Sept.1961	15	.1r	H	9	340	95 ft. H_2S odor
1242	4245	H.L. Althouse	Clarence Wink	1966	655	70	24	6	40,68	V	Omp	40	Aug. 1966	7	–	H	7	120	
1243	4045	Mrs. Esther Reis	R.H. Odenheimer Co.	1968	560	152	53	6	75,145	V	Omp	30	Feb. 1968	10	–	H	–	–	
1244	4145	Paul A. Burbes	do.	1964	680	110	–	6	–	H	Omr	–	–	–	–	H	3	150	
1245	4245	Dale L. Snyder	Harry Todd	1967	590	196	33	6	70,188,196	V	Omr	F	Oct. 1968	45	–	H	2	280	H_2S odor
1246	4246	Paul Shellhamer	Wessner	1957	650	72	20	6	–	S	Omp	8	–	–	–	H	6	250	
1247	4146	Jacob M. Everett	R.H. Odenheimer Co.	1964	645	105	22	6	65,100	H	Omr	30	Oct. 1964	12	–	H	6	300	
1248	4147	Charles Rauch	Harry Todd	1959	590	65	–	6	–	S	Omp	–	–	–	–	H	4	270	H_2S odor
1249	3239	Terry Hill Mobile Homes Estate	R.H. Odenheimer Co.	1958	480	208	54	6	95,200	S	Omb	98	Sept. 1968	25	–	P	5	220	
1250	3239	do.	do.	1958	470	274	25	6	98,268	V	Omb	75	–	25	–	P	6	230	Limestone 264-274
1251	3239	Durell Shellhamer	Lehigh Valley Well and Pump Co.	1968	440	118	73	6	30,72,80,98	S	Omb	19	May 1968	50	–	H	5	260	
1252	3338	Glen Witmer	R.H. Odenheimer Co.	1968	640	185	25	6	50,92,160	H	Omb	50	July 1968	6	–	H	–	–	
1253	4049	Mrs. Shirley Wright	Kermit Snyder	1967	560	93	30	6	–	S	Omp	–	–	43	–	H	–	–	
1254	4049	Benjamin Dietrich	do.	1968	545	112	40	6	–	H	Omp	20	Sept. 1968	30	–	H	–	–	Filled with concrete
1255	4050	Clyde Utt	E.C. Lenhart	1959	460	152	–	6	45,89,112,125	S	Omr	10	Aug. 1959	9	.3r	H	6	320	below 130 feet to
1256	4050	do.	–	1930	480	185	–	6	–	S	Omr	–	–	50	–	H	7	310	eliminate H_2S
1257	4050	George Sensinger	Clarence Wink	1954	500	137	29	6	75,110	S	Omp	60	Oct. 1954	10	–	H	9	350	
1258	3952	William Heffner	E.C. Lenhart	1965	540	84	30	6	–	S	Omp	25	June 1965	20	.5r	H	8	330	
1259	3951	Carl Kramer	do.	1965	490	117	22	6	29,47,72	S	Omp	20	June 1965	10	.1r	H	–	–	
1260	3948	Guy J. Leiby	do.	1960	550	132	30	6	67,103,132	V	Omr	25	May 1960	5	.04r	H	–	–	H_2S odor
1261	3948	Norman J. Smith	Homer Herman	1963	650	68	33	6	–	V	Omr	17	Sept. 1963	–	–	H	6	250	
1262	4144	Harold Oswald	Russell Pugh	1968	630	118	48	6	68,89,116	S	Omr	25	Sept. 1968	15	.5r	H	–	–	
1263	3945	Phillip Snyder	Clarence Wink	1968	740	250	42	6	42,225	S	Omr	36	Oct. 1968	4	–	H	–	–	
1264	3945	Willard B. Hamm	do.	1963	780	200	62	6	195	V	Omr	60	July 1963	10	–	H	2	140	Cement filled below
1265	3845	Mrs. William Kistler, Sr.	do.	1965	630	87	39	6	42,75	V	Omr	40	1965	20	–	H	5	250	190 ft. H_2S odor
1266	3846	Homer Snyder	Kermit Snyder	1960	640	80	–	6	–	V	Omr	8	–	–	–	H	6	–	
1267	3747	Henry J. Kohler	do.	1964	640	110	26	6	100	V	Omr	38	Nov. 1964	13	–	S	–	–	
1268	3748	Paul Zimmerman	E.C. Lenhart	1957	490	150	45	6	90,143	V	Omb	10	Apr. 1957	17	.2r	H	9	320	
1269	3947	Henry A. Gruber	Clarence Wink	1960	730	400	21	6	80,200,280,400	H	Omr	70	Mar. 1960	25	.08r	S	6	450	
1270	4130	Dennis Bankos	Robert Kocher	1967	435	200	43	6	85,170,195	S	Omb	85	June 1967	6	.05r	H	14	510	
								NORTHAMPTON COUNTY											
Np 21	4708	Ziga Sabo	–	–	–	103	–	6	–	S	Omb	11	Feb. 1952	–	–	H	–	–	
47	4536	American Nickeloid Co.	C.D. Moyer	1965	380	1,177	–	10	–	S	Omp	24	Nov. 1965	65	–	N	–	–	
101	4520	Floyd Rapp	Floyd Rapp	1955	750	96	12	6	–	H	Omb	15	June 1955	7	–	H	5	210	pH 6.6
102	4518	Raymond Messinger	do.	1961	640	82	18	6	–	H	Omb	13	Nov. 1961	12	–	H	16	550	pH 6.6
103	4618	Sterling Bickert	do.	1960	670	106	7	6	–	H	Omb	–	–	12	–	H	–	–	
104	4617	Mary H. Stites	do.	1961	470	100	43	6	–	V	Omb	–	–	11	–	H	3	120	

Table 6. *(Continued)*

Well No.	Location No.	Owner	Driller	Year drilled	Altitude above sea level (feet)	Well depth (feet)	Casing depth (feet)	Casing diameter (inches)	Depth to water-bearing zone (feet)	Topo. setting	Aquifer	Static water level: Depth below land surface (feet)	Static water level: Date measured	Reported yield (gpm)	Specific capacity (gpm per ft)	Use	Field analyses of water: Hardness (grains per gal.)	Field analyses of water: Specific conductance (micromhos at 25°C)	Remarks
Np-105	4716	Robert Tenges	do.	1964	460	43	12	6	–	V	Omb	F	Sept. 1964	10	–	H	7	250	pH 7.7
106	4518	Raymond Snyder	do.	1966	660	170	8	6	–	H	Omb	–	–	5	–	H	12	–	
107	4519	Warren Bickert	do.	1964	590	90	11	6	–	S	Omb	–	–	12	–	H	–	–	
108	4622	Arnold Krock	do.	1965	790	170	20	6	–	H	Omb	–	–	12	–	H	–	–	
109	4722	Odell Kleppinger	do.	1966	710	80	35	6	–	V	Omb	12	May 1966	12	.16u	H	7	280	
110	4722	Harold Bloss	do.	1961	690	70	46	6	–	S	Omr	–	–	30	–	H	3	135	pH 7.1
111	4823	John Danner	do.	1951	770	85	84	6	–	S	Qg	F	–	50	–	P	1	50	pH 6.6
112	4723	Hubert Remaley	do.	1965	740	55	38	6	–	V	Omr	–	–	30	–	H	–	–	
113	4624	Mellous Leibola	do.	1966	840	75	21	6		S	Omr	–	–	10	–	H	3	120	pH 6.1
114	4524	Harold Kocher	do.	1964	725	315	3	6	–	S	Omb	–	–	2	–	H	10	420	pH 7.1
115	4523	David Minnich	do.	1965	705	80	28	6	–	S	Omb	15	Aug. 1965	12	–	H	4	200	pH 6.5
116	4431	Burdell Templeton	Robert Kocher	1957	720	125	33	6	–	V	Omr	–	–	30	–	H	7	250	pH 7.6
117	4433	George Strohl	do.	1965	740	200	41	6	50,183,200	H	Omr	–	–	10	–	H	4	–	pH 6.0
118	2748	Michael Ilko	R. H. Odenheimer Co.	1965	830	135	–	6	130	S	Omp	35	Aug. 1965	40	–	H	1	<50	
119	4630	Joseph Steirer	do.	1965	530	87	40	6	85	S	Omr	2	Oct. 1965	25	–	H	6	210	H_2S odor
120	4323	Willard Diehl	Robert Kocher	1965	500	150	18	6	–	S	Omb	23	Nov. 1965	10	–	H	11	420	pH 7.0
121	4624	Nicholas Kopchak	Charles Rumsay	1961	790	70	53	6	–	V	Omb	40	Dec. 1961	15	3.r	H	4	170	pH 7.0
122	4625	Thomas Silfies	Charles Itterley	1965	850	125	68	6	–	V	Omr	–	–	–	–	H	2	115	pH 6.0
123	4625	Henry Weber	Frank Tomsic	1965	790	110	50	6	–	S	Omr	–	–	–	–	H	5	200	pH 6.3
124	4533	Fay Warren	R. H Odenheimer Co.	1966	640	178	24	6	170	H	Omp	45	Mar. 1966	15	–	H	–	–	
125	4628	John Derr	do.	1966	660	72	54	6	70	V	Omr	F	–	20	–	H	5	200	
126	4425	Earl Eberts	do.	1966	720	63	24	6	35,60	S	Omb	15	Mar. 1966	50	–	H	–	–	
127	4419	Kenneth Billheimer	do.	1965	695	165	21	6	160	S	Omb	50	July 1965	3	–	H	10	400	
130	5607	Louis Cyr	Frank Tomsic	1962	620	100	70	6	95	S	Omr	8	June 1962	55	–	H	6	220	
131	5608	Morris Cohon	–	1958	690	45	45	6	40	S	Qg	15	–	–	–	H	6	225	
132	5608	do.	–	1936	690	80	25	6	–	S	Omr	26	Aug. 1966	–	3.9u	H	7	250	
133	5608	do.	E. R. Bush	1958	730	300	10	6	–	S	Omr	–	–	–	–	H	14	460	
134	5405	do.	Frank Tomsic	1958	450	300	17	6	–	S	Omb	F	1958	4	.27u	H	14	420	H_2S odor
135	5406	do.	–	–	610	80	–	6	–	S	Omb	17	Aug. 1966	–	.65u	H	14	430	
136	5405	do.	–	–	500	100	–	6	–	S	Omb	11	–	–	.08u	H	10	320	

137	5608	Portland Borough	R. H. Odenheimer Co.	1956	720	500	90	10	–	S	Omr	F	June 1966	17	.06r	.P	4	120		
138	5608	do.	do.	1965	870	800	128	10	–	S	Omr	165	June 1966	150	–	P	3	110		
139	5609	Karl Vliet	George Shoemaker	1954	879	57	–	6	–	S	Omp	–	–	–	–	H	2	58		
140	5609	Albert Koelliker	Frank Tomsic	1966	825	180	180	6	–	S	Qg	15	–	15	–	H	5	175	H_2S odor	
141	5607	Mrs. Walter Grosskopf	Allen	1930	700	150	–	6	–	S	Omr	–	–	–	–	H	7	250		
142	5607	Robert Jewell	do.	1950	710	155	–	6	–	H	Omr	60	–	–	–	H	7	225		
143	5507	Albert Kearney	do.	–	680	103	55	6	87	S	Omr	9	–	–	–	H	4	150		
144	5507	Mrs. Gertrude Osterbye	E.R. Bush	1960	685	110	12	6	97	S	Omr	12	–	–	–	H	7	240		
145	5506	William Delp	C.D. Moyer	1961	480	555	–	6	–	S	Omb	–	–	–	–	H	3	450		
146	5506	Angelo Guarreia	Frank Tomsic	1966	420	95	95	6	90	S	Qg	30	–	20	–	H	–	–		
148	5507	Paul Raesly	C.D. Moyer	1963	460	140	139	6	–	S	Omb	F	–	–	–	H	11	300		
149	5407	John Villari	–	1922	460	48	–	6	–	U	–	7	–	–	–	H	11	310		
150	5407	Arnold Arsel	Frank Tomsic	1958	420	65	65	6	–	V	Qg	F	–	20	–	H	12	315		
151	5406	Myrtle Woolever	do.	1960	530	173	–	6	–	S	Omb	10	–	6	–	C	23	1,000		
152	5404	Stanley Sosnovik	Donald Kitchen	1963	300	102	–	6	85	S	Omr	20	–	10	–	H	11	320		
153	5404	Met. Edison Elect. Co.	Layne-New York Co.	1957	290	66	–	10	31-64	V	Qg	24	June 1957	230	12.r	N	–	–		
154	5404	do.	do.	–	290	551	–	–	–	V	Omb	9	–	80	.06r	–	–	–		
155	5404	do.	R.H. Odenheimer Co.	1955	300	250	60	8	–	V	Omb	28	–	27	–	U	–	–		
156	5404	do.	Layne-New York Co.	1957	290	404	–	10	–	V	Omb	22	June 1957	12	–	U	–	–		
157	5305	Alfred Reinhardt	William Broad	–	580	110	40	6	80,97,107	S	Omr	26	–	10	–	H	10	300		
158	5306	Val Fontanella	–	–	620	150	–	6	–	S	Omr	13	June 1966	–	–	H	7	230		
159	5305	Ralph C. Predmore	Hooper	1955	590	121	21	6	60,90,96,102	S	Omr	10	–	55	–	H	10	340		
160	5304	Robert Brodt	Raymond Werner	–	300	160	48	6	150	S	Omr	68	–	14	.20u	H	3	310	H_2S odor	
161	5304	Ralph Ginter,DDS	Frank Tomsic	1963	–	240	50	6	–	V	Omr	–	–	20	–	H	9	330		
162	5203	Earl R. Ackerman	do.	1966	260	110	110	6	–	V	Qg	–	–	75	–	P	9	280		
163	5304	Tuscarora Inn	–	1955	290	220	–	–	–	V	Omr	–	–	–	–	C	9	280		
164	5205	Warren Shoemaker	William Broad	–	410	130	20	6	38 + others	V	Omr	15	–	50	–	H	10	330		
165	5206	Henry Sandt	do.	1955	550	170	46	6	48	V	Omr	15	–	20	7.r	H	7	235		
166	5206	Franklin A. Smith	–	1917	665	94	23	6	–	H	Omr	9	–	–	–	H	7	245		
167	5205	L.R. Shoemaker	Frank Tomsic	1963	560	245	88	6	–	S	Omr	22	June 1966	6	–	H	8	300		
168	5205	Marvin Shoemaker	Raymond Werner	1966	630	108	44	6	54	H	Omr	28	–	9	–	H	–	–		
169	5204	Ben Skrzypek	–	–	560	180	–	6	–	H	Omr	35	June 1966	10	–	H	16	600		
170	5105	Harold P. Miller	William Broad	1955	500	136	15	6	50,70 + others	S	Omr	19	–	30	–	H	8	320		
171	5104	Albert Frutchey	Allen	1910	485	75	11	6	–	S	Omr	10	–	–	–	H	8	250		
172	5104	Henry M. Ransom	–	–	320	90	30	6	–	S	Omb	27	–	–	–	H	8	290		
173	5307	B.G. Bonney	Frank Tomsic	–	570	105	3	6	20,60,100	H	Omb	7	–	15	–	H	18	575		
174	5106	Ella Frankel	–	1930	510	220	–	6	–	S	Omb	–	–	–	–	C	9	280		
175	5106	do.	–	1930	480	67	–	6	–	V	Omr	29	June 1966	–	–	C	11	380		
176	5106	do.	Frank Tomsic	1964	530	230	25	6	–	S	Omr	71	June 1966	15	.46u	C	9	300		
177	5106	Oscar Hillard	do.	1964	700	275	10	6	–	V	Omr	F	–	5	–	H	7	245		

Table 6. *(Continued)*

Well No.	Location No.	Owner	Driller	Year drilled	Altitude above sea level (feet)	Well depth (feet)	Casing depth (feet)	Casing diameter (inches)	Depth to water-bearing zone (feet)	Topo. setting	Aquifer	Static water level: Depth below land surface (feet)	Static water level: Date measured	Reported yield (gpm)	Specific capacity (gpm per ft)	Use	Field analyses of water: Hardness (grains per gal.)	Field analyses of water: Specific conductance (micromhos at 25°C)	Remarks
Np-178	5107	Elton Ott	–	1930	680	110	9	6	–	S	Omr	–	–	–	–	H	9	330	
179	5007	George Ott	–	1930	680	45	6	6	–	S	Omr	15	–	–	.87u	H	7	265	
180	5006	Elmer Wade	–	–	540	175	–	6	–	S	Omb	110	–	–	–	H	7	245	
181	4905	Charles Hensil	Frank Tomsic	1965	270	245	–	6	–	V	Omb	27	June 1966	80	2.2u	H	12	400	
182	4906	Willard R. Hess	–	–	660	110	–	6	–	H	Omb	–	–	–	–	H	10	300	
183	5006	Clarence Smith	Raymond Werner	1965	605	290	47	6	–	S	Omb	48	June 1966	10	.07u	H	8	290	
185	5508	Frank Fentzloff	Frank Tomsic	1965	685	80	80	6	–	S	Qg	–	–	9	–	H	9	280	
186	5509	John Poliskiewicz	do.	1958	790	105	37	6	50,85	S	Omr	30	–	10	–	H	7	130	
187	5509	Peter Poliskiewicz	William Broad	1950	770	140	120	6	125	S	Omr	47	–	10	–	H	5	145	
188	5509	S.G. Wolf, MD	–	–	740	35	–	6	–	V	Qg	F	–	–	–	H	3	85	
189	5509	Totts Gap Institute	Charles Rumsay	1966	770	200	88	6	–	S	Omr	50	–	50	–	H	8	260	
190	5510	do.	Frank Tomsic	–	750	150	125	6	–	V	Omp	24	Aug. 1966	30	.37u	H	4	130	
191	5510	do.	–	–	715	–	–	–	–	S	–	–	–	–	–	H	4	120	
192	5510	Andrew Steen	–	–	730	69	20	6	–	S	Omp	9	–	–	–	H	10	280	
193	5512	Martin Sullivan	–	1958	1,045	133	65	6	–	S	Omp	20	–	38	–	H	2	55	
194	5512	East Bangor Borough	–	1949	910	401	401	6	–	S	Omp	50	–	–	–	P	–	–	
195	5512	do.	–	–	910	135	75	6	–	S	Omp	F	June 1966	130	–	P	2	55	
196	5511	Al Nittle	–	–	840	365	365	6	90,150,365	S	Omp	–	–	113	.8r	P	4	145	
197	5512	Kirkridge, Inc.	Charles Rumsay	1964	1,020	180	35	6	–	S	Omp	–	–	25	–	H	3	80	
198	5410	T. Roland LaBar	T. Roland LaBar	–	700	36	21	6	–	S	Omp	8	June 1966	5	.22u	H	7	200	
199	5412	Norman Lohman	George Shoemaker	–	815	65	60	6	–	S	Omp	F	–	–	–	H	3	70	
200	5410	Grover Zeigafuse, Jr.	Frank Tomsic	1956	700	130	80	6	–	S	Omp	20	–	20	–	H	8	230	
201	5409	Karl Zeigafuse	Karl Zeigafuse	1954	730	85	11	6	84	S	Omr	28	–	–	–	H	6	190	
202	5409	John Bocko	William Broad	1942	690	97	–	6	–	S	Omr	–	–	–	–	H	9	330	
203	5409	Mike Bocko	Frank Tomsic	1963	775	220	20	6	–	S	Omr	30	–	12	–	H	9	265	
204	5411	H.A. Davis	Charles Rumsay	1965	690	127	89	6	92,120	V	Omp	5	–	13	–	H	8	235	
205	5408	E. Mathies	Frank Tomsic, Sr.	1946	625	65	–	6	–	S	Omr	27	June 1966	30	–	H	8	210	
206	5408	F. Simon	do.	1952	550	74	74	6	–	U	Qg	15	–	30	–	H	10	270	
207	5308	Eugene Lohman	Joseph Kasmakites	1966	550	162	162	6	–	U	Qg	8	June 1966	80	–	H	9	260	
208	5307	H.A. Hartzell	Frank Tomsic	1963	580	165	60	6	–	H	Omb	15	–	10	–	H	13	335	
209	5207	Joseph Zeman	Hooper	1954	550	65	65	6	–	S	Qg	F	June 1966	–	–	H	9	290	

210	5208	Albert Palmer	Paul Genther	1935	585	85	10	6	8,50	S	Omb	3	1963	8	–	H	10	300	
211	5207	do.	Hooper	–	595	70	5	6	19 + others	S	Omb	9	Aug. 1955	20	–	H	9	290	
212	5208	Mrs. V. Hester	Allen	–	630	78	–	6	–	S	Omb	–	–	–	–	H	14	400	
213	5309	Bangor Senior High School	R.H. Odenheimer Co.	1955	670	400	100	8	145,397	H	Omb	30	Feb. 1959	60	.4r	P	12	400	
214	5209	Ira Dutt	–	1910	–	90	–	6	–	S	Omb	8	–	–	–	H	10	290	
215	5204	Steven Alpert	Frank Tomsic	1964	605	140	20	6	100	H	Omr	40	July 1964	30	–	H	–	–	
216	5204	do.	C. D. Moyer	1965	795	140	–	6	–	H	Omr	–	–	15	–	H	–	–	
217	5309	Ockeys Hotel	Al Emele	1946	585	72	72	6	–	V	Qg	28	June 1966	–	–	C	9	295	
218	5310	Hans Anderson	Rapp	–	750	45	45	6	–	H	Qg	–	–	–	–	H	6	270	
219	5311	Lorian LaBar	Frank Tomsic	1962	785	115	25	6	–	S	Omr	–	–	15	–	H	–	–	
220	5310	J.J. Manuf. Co., Inc.	–	–	620	75	–	6	–	S	Omr	6	–	–	–	H	4	190	
221	5310	John L. Miller	Frank Tomsic	1965	630	305	30	6	–	S	Omr	30	–	8	–	H	6	240	
222	5210	Joseph Drexler	Charles Rumsay	1964	680	100	–	6	–	S	Omr	–	–	12	–	H	6	220	
223	5311	Weldon J. Merritt	Rapp	1957	810	101	–	6	–	H	Omr	25	–	8	–	H	11	455	
224	5212	Peter W. Korell	George Shoemaker	1954	670	180	40	6	175	S	Omr	55	June 1966	–	–	H	7	265	
225	5312	William Stone	–	–	670	90	–	6	–	S	Omp	–	–	–	–	H	6	250	
226	5312	Russell Beck	Frank Tomsic	1963	630	125	90	6	–	V	Omp	20	–	25	–	H	4	140	
227	5207	Margaret Sandt	–	1935	670	85	–	6	60,80	S	Omr	40	–	16	–	H	8	280	
228	5208	Edward T. Shannon	–	–	670	96	–	6	–	S	Omr	30	–	–	–	H	9	335	
229	5209	Harry Callie	Rapp	1940	660	87	20	6	–	S	Omb	40	–	–	–	H	6	240	
230	5209	Samuel Callie	do.	1955	655	270	10	6	50	S	Omb	20	–	–	–	H	10	370	
231	5210	Stella Messinger	do.	1948	710	180	–	6	–	S	Omr	–	–	–	–	H	3	110	
232	5211	Kenneth Roberts	do.	1959	680	102	70	6	80	V	Omr	F	–	–	–	H	7	240	H_2S odor
233	5111	Claude Schultz	William Broad	1955	665	160	59	6	90-100	S	Omr	20	–	5	–	U	–	–	
234	5110	Roy Bushkirk, Sr.	Hooper	1959	710	130	50	6	86	H	Omb	50	–	8	–	H	6	270	
235	5110	Lester Reimer	Paul Genther	1939	620	125	20	6	–	S	Omr	20	–	–	–	H	3	150	
236	5110	Paul Dunbar	Stanley Rapp	1960	660	226	–	6	–	S	Omb	19	June 1966	8	–	H	7	300	
237	5109	Mrs. Alice Schoen	–	–	630	135	–	6	–	S	Omr	17	–	–	–	H	9	320	
238	5108	John Hann	–	–	700	65	–	6	–	V	Omr	11	June 1966	–	1.8u	H	9	330	
239	5107	Mrs. Curtis Forner	–	–	700	83	30	6	–	S	Omr	12	June 1966	–	–	H	4	200	
240	5108	Richard Cronce	R.S. Sipple	1964	680	250	30	6	120 + others	S	Omr	30	–	4	–	H	9	330	
241	5008	Richmond Meth. Epis. Ch.	–	–	520	160	80	6	–	V	Omr	19	June 1966	–	.59u	T	6	260	
242	5109	Kurt Sonntag	–	–	630	70	–	6	–	S	Omb	F	–	–	–	H	9	300	
243	5007	Floyd Ott	William Broad	1952	500	102	11	6	–	V	Omb	9	–	–	–	H	6	250	H_2S odor when drilled
244	5007	George L. Falteich	Frank Tomsic	1962	570	238	40	6	–	S	Omb	30	–	6	–	H	6	290	
245	5117	Blue Mtn. Consol. Water Co.	–	1918	890	135	130	10	–	S	Omp	F	1964	185	2.r	P	–	–	
246	4619	do.	–	1921	550	333	33	10	–	V	Omb	51	Oct. 1966	–	–	U	–	–	
247	4619	do.	–	1921	545	226	33	10	–	V	Omb	38	Sept. 1966	–	–	U	–	–	
248	4620	do.	–	–	550	407	50	10	–	V	Omb	25	–	430	–	P	–	–	
249	5215	do.	–	1908	1,070	307	150	8	–	S	Omp	–	–	50	–	P	–	–	

Table 6. *(Continued)*

Well No.	Location No.	Owner	Driller	Year drilled	Altitude above sea level (feet)	Well depth (feet)	Casing depth (feet)	Casing diameter (inches)	Depth to water-bearing zone (feet)	Topo. setting	Aquifer	Static water level: Depth below land surface (feet)	Static water level: Date measured	Reported yield (gpm)	Specific capacity (gpm per ft)	Use	Field analyses of water: Hardness (grains per gal.)	Field analyses of water: Specific conductance (micromhos at 25°C)	Remarks
Np-250	5009	Clyde W. Stevens	Red Shea	1930	740	210	20	6	30,175	H	Omr	20	–	–	–	H	6	290	
251	5009	Joseph H. Lockard	Raymond Werner	1965	700	97	20	6	85	V	Omr	42	Aug. 1966	40	–	H	8	350	
252	5010	John H. Heinsohn	Joseph Kasmakites	1964	640	120	25	6	90	H	Omr	35	–	60	–	H	19	820	
253	5010	do.	do.	1964	620	85	20	6	60	V	Omr	11	–	12	–	H	–	–	
254	5010	do.	do.	1964	690	75	20	6	–	S	Omr	11	–	5	–	H	–	–	
255	5010	do.	William Broad	1960	580	65	20	6	–	S	Omb	–	–	–	–	H	–	–	
256	5011	William P. Doall	Hooper	1954	620	270	12	6	–	S	Omb	30	–	3	–	H	8	350	
257	5011	Mrs. John Quinn	–	–	410	85	–	6	–	S	Omb	65	–	–	–	H	5	270	
258	5012	Carl Tolino	Charles Rumsay	1964	440	200	22	6	135,185	S	Omb	31	–	8	.04u	H	4	250	H_2S odor
259	5113	Frank Pellechia	Frank Tomsic	1964	635	165	124	6	160	S	Omr	5	Jan. 1966	60	–	H	5	240	
260	5113	John Christman, Sr.	William Broad	1956	600	165	90	6	–	S	Omr	15	–	–	–	H	5	220	
261	5013	Julius Christoff	Hooper	1956	550	118	42	6	9,60	S	Omr	9	–	–	–	H	4	180	
262	5114	John Repscher, Jr.	Charles Rumsay	1965	750	128	40	6	–	S	Omp	30	–	–	–	H	4	180	
263	5114	Pen Argyl Milling Co.	Rapp	1930	600	110	–	6	–	V	Omp	90	–	–	–	N	5	260	H_2S odor
264	5013	Harry Weiss	Hooper	1954	590	135	40	6	40,135	H	Omr	–	–	19	–	H	4	180	
265	5015	Leo Suprys	Rapp	1950	750	180	10	6	30	S	Omr	50	–	2	–	H	–	–	
266	5015	do.	Leo Suprys	–	740	140	20	6	110	S	Omp	50	–	15	–	H	6	290	
267	5014	John Zuleski	Rapp	–	725	112	–	6	–	H	Omr	40	–	–	–	H	–	–	
268	4914	Fred Achenbach	do.	1946	650	78	20	6	68	V	Omr	4	–	20	–	H	4	210	
269	4915	do.	S.Y. Moyer	–	660	85	40	6	–	S	Omr	–	–	–	–	H	7	300	
270	4914	Erwin Finken	Rapp	1956	620	90	20	6	16,30,40-50,60,90	S	Omb	17	–	15	–	H	12	500	
271	4913	Paul Richards	–	–	540	250	38	6	250	S	Omb	32	–	3	–	H	6	340	
272	4913	R.W. Fritzshe, MD	–	1951	660	110	25	6	18,90	H	Omb	20	July 1965	17	.1u	H	4	200	
273	4912	Amos E. Ackerman	Kocher	1964	440	110	25	6	–	V	Omb	12	–	20	–	H	5	260	
274	4912	Dino Perelli	Raymond Werner	1964	400	115	38	6	90	V	Omb	20	–	6	–	H	8	310	
275	4911	Willard Lattig	Rapp	1945	670	197	14	6	–	H	Omb	35	1963	–	–	H	7	320	
276	4911	Daniel Falcone	–	–	670	149	–	6	–	S	Omr	73	–	–	–	H	–	–	
277	4911	W.C. Hopstetter	–	–	700	165	–	6	–	H	Omr	55	Oct. 1966	–	.2u	H	7	300	
278	4911	Nick Falcone	–	–	550	120	–	6	–	V	Omr	–	–	–	–	H	–	–	
279	4910	Harvey L. Rasley	Stanley Rapp	1963	540	140	50	6	75,120	S	Omb	12	–	30	–	H	8	350	
280	4910	William Weston	do.	1944	660	125	45	6	–	S	Omr	45	–	–	–	H	8	340	

281	4909	Kenneth Brewer	Kocher	1964	560	130	90	6	–	V	Omb	25	Sept. 1966	30	0.30u	H	6	240	
282	4909	Dale Widdoss	William Broad	1957	690	160	–	6	–	H	Omb	40	–	–	–	H	9	320	
283	4909	Willard R. Hess	C. D. Moyer	1966	690	580	20	6	300,576	H	Omb	141	–	18	.04u	H	4	220	
284	4907	J.H. Keifer	Charles Rumsay	1965	380	65	30	6	30	V	Omb	30	–	–	–	H	7	265	
285	4908	Edwin B. Miller, Sr.	–	1963	540	80	32	6	54	S	Omb	13	Sept. 1966	11	–	H	7	270	
287	4808	George Shoemaker	–	–	550	145	10	6	–	S	Omb	28	Sept. 1966	3	–	H	9	340	
288	4809	George C. Ott	–	1950	620	125	–	6	–	S	Omb	65	–	–	–	H	13	480	
289	4809	do.	Charles Rumsay	–	610	180	–	6	160,175	S	Omb	50	–	20	–	H	13	480	
290	4810	Frank Borbas	Rapp	1947	480	175	–	6	30,60	S	Omb	–	–	5	–	H	15	510	
291	4810	H.J. Stolten	–	–	400	100	–	6	–	V	Omb	–	–	–	–	H	7	260	
292	5313	Bangor Water Co.	Allen	1908	920	268	150	8	–	V	Omp	–	–	–	–	U	–	–	
293	5413	do.	do.	1914	880	165	94	10	–	S	Omp	F	–	75	–	P	–	–	
294	5512	do.	do.	1914	1,030	142	120	12	–	S	Omp	F	–	200	–	P	–	–	
295	5412	do.	do.	1915	1,000	150	113	10	–	S	Omp	F	–	280	–	P	–	–	
296	5512	do.	do.	1916	960	244	134	10	–	S	Omp	F	–	360	–	P	–	–	
297	5512	do.	–	1915	960	380	128	10	–	S	Omp	F	–	200	–	P	–	–	
298	5512	do.	–	1916	940	517	192	10	–	S	Omp	8	–	200	–	U	–	–	
299	5512	do.	Allen	1916	910	158	100	10	–	S	Omp	F	–	100	–	P	–	–	
300	5512	do.	–	1916	950	38	38	8	–	S	Omp	F	–	–	–	U	–	–	
301	5512	do.	Allen	1916	950	147	54	10	–	S	Omp	–	–	–	–	U	–	–	
302	5412	Bangor Water Co.	Allen	1922	980	350	150	10	–	S	Omp	–	–	–	–	U	–	–	
303	5412	do.	do.	1922	980	80	60	10	–	S	Omp	–	–	–	–	U	–	–	
304	5412	do.	do.	1922	1,000	114	90	10	–	S	Omp	–	–	–	–	U	–	–	
305	5313	do.	Kohl Bros.	1955	910	1,030	54	12	180,350	S	Omp	8	–	100	–	P	–	–	
306	5512	do.	A.C. Schultes	1963	930	165	100	8	–	S	Omp	F	–	100	–	P	–	–	
307	4811	Louis Sipos	–	–	310	70	10	6	–	V	Omb	13	–	–	–	H	8	310	
308	4812	Paul E. LaBar	Rapp	1954	370	112	78	6	–	V	Omb	–	–	–	–	H	8	290	
309	4812	Edward Bloodworth	–	–	600	125	50	6	–	S	Omb	20	–	14	–	H	5	200	
310	4812	Karl Kachline	Raymond Werner	1963	610	166	20	6	85,165	S	Omb	25	–	15	–	H	6	230	
311	4813	William Horn	Robert Kocher	1962	660	137	80	6	–	S	Omb	40	1966	60	2.r	H	5	190	
312	4814	Rudolf Kroboth	Floyd Rapp	1952	760	147	–	6	55,145 + other	H	Omr	–	–	24	-	H	5	210	
313	4814	C.W. Meixsell	–	–	690	96	–	6	–	H	Omb	36	–	–	–	H	–	120	
314	4714	Edward Tadajweski	Stanley Rapp	1958	650	100	20	6	–	S	Omb	40	–	8	–	H	6	230	
315	4714	Kathleen Paukovitch	do.	1958	570	225	40	6	25	V	Omb	F	–	6	–	H	–	–	H_2S odor
316	4713	Norman Roberts	Frank Tomsic	1963	380	260	40	6	80,180,260	V	Omb	O	Sept. 1963	90	–	H	9	345	
317	5212	Bangor Water Co.	Allen	1925	700	590	500	10	–	H	Omr	–	–	–	–	U	–	–	
318	4713	Arthur Hahn	Floyd Rapp	1952	605	110	8	6	64,100	H	Omb	24	Jan. 1952	14	–	H	13	540	
319	4712	Anthony Skovronsky	Stanley Rapp	1958	610	96	20	6	10 + other	H	Omb	20	1958	5	–	H	15	550	
320	4711	Peter Plebani	Peter Plebani	1946	290	110	48	6	55	V	Omb	60	1955	12	–	H	12	400	
321	4711	Joseph Piergallini	Raymond Werner	1963	290	90	20	6	–	V	Omb	–	–	40	–	H	15	625	

Table 6. *(Continued)*

Well No.	Location No.	Owner	Driller	Year drilled	Altitude above sea level (feet)	Well depth (feet)	Casing depth (feet)	Casing diameter (inches)	Depth to water-bearing zone (feet)	Topo. setting	Aquifer	Static water level: Depth below land surface (feet)	Static water level: Date measured	Reported yield (gpm)	Specific capacity (gpm per ft)	Use	Field analyses of water: Hardness (grains per gal.)	Field analyses of water: Specific conductance (micromhos at 25°C)	Remarks
Np-323	4710	James Siegfried, Jr.	Kocher	1960	595	100	–	6	70	S	Omb	F	–	15	–	H	17	560	
324	4709	Julius Savo	William Broad	1955	620	175	20	6	75	H	Omb	–	–	–	–	H	12	420	
328	4611	Peter Romanish	Floyd Rapp	1956	570	285	18	6	125	S	Omb	100	1956	6	–	H	16	580	
329	4612	do.	Raymond Werner	1962	580	207	12	6	–	S	Omb	F	1962	5	–	H	13	450	
330	4612	Edward Stanchus	Stanley Rapp	1960	580	100	5	6	70	V	Omb	10	1960	20	–	H	14	500	
333	4613	Raymond P. Werkheiser	Floyd Rapp	1944	650	161	11	6	55	S	Omb	20	–	3	–	H	13	530	
334	4614	do.	do.	1961	660	146	30	6	100	S	Omb	20	–	8	–	H	15	500	
335	4613	Kenneth Kulp	do.	1949	690	147	6	6	145	H	Omb	20	–	20	–	H	–	–	
336	4614	Adam Inboden	S.J. Letson	1956	670	94	15	6	30,60,94	H	Omb	18	July 1966	4	–	H	24	1,300	
337	5115	Irene McWilliams	Stanley Rapp	1952	680	100	15	6	95	H	Omp	30	Sept. 1966	5	–	H	9	420	
338	5015	G. Williams, Jr.	Frank Tomsic	1965	600	350	25	6	100	S	Omr	–	–	4	–	H	9	350	
339	5016	Herman Hattesaul	do.	1957	610	125	18	8	70	S	Omr	F	Aug. 1957	15	–	H	6	235	
340	5016	Fred B. Davis	–	1940	665	75	–	6	–	S	Omp	17	–	–	–	H	3	140	
341	5017	John H. Itterly	Kocher	1965	750	130	94	6	87,113-118	S	Omp	25	–	35	2.r	H	4	145	
342	5018	Reuben Reese	Frank Tomsic	1958	710	226	225	6	–	V	Omp	40	–	12	–	H	3	120	
343	4922	Arthur Hess	Floyd Rapp	1960	810	112	98	6	–	S	Omp	F	–	15	–	H	1	<50	
344	4921	E.A. Dorshimer, Sr.	Anthony Tomsic	1957	810	191	163	6	–	S	Omp	F	–	40	–	H	3	80	
345	4921	Joseph Young	Frank Tomsic	1963	745	180	140	6	–	S	Omp	F	–	30	–	H	3	100	
346	4920	Russell Lieberman	Robert Kocher	1963	695	76	53	6	–	S	Omp	33	–	20	10.r	H	1	<50	
347	4920	R.H. Davidson	Frank Tomsic	1959	810	147	147	6	–	S	Qg	F	Sept. 1966	–	–	H	1	<50	
348	4919	George Hardy, Sr.	Frank Tomsic	1958	670	85	20	6	–	S	Omp	24	–	13	–	H	6	220	
349	4919	Robert G. Hoffman	do.	–	690	305	92	6	80,135,300	S	Omp	45	–	6	–	H	3	120	
350	4918	John Holloway	–	1938	660	108	30	6	90,108	S	Omp	28	–	20	–	H	6	185	
351	4918	George W. Walter	Frank Tomsic	1944	690	101	60	6	60,100	S	Omp	27	–	–	–	H	3	110	
352	4917	Arthur P. Miller	Stanley Rapp	–	680	82	80	–	–	S	Omp	F	–	–	–	H	6	200	
353	4916	Dale Kipple	Frank Tomsic	1960	710	225	15	6	220	S	Omr	20	–	10	–	H	5	195	
354	4916	A.M. Rutkowske	do.	1951	600	110	15	6	80-90	V	Omr	25	July 1966	20	–	H	6	235	
355	5707	Philip Morrissey	–	–	320	157	–	6	–	V	–	–	–	–	–	H	5	175	
357	4915	Ronald Achenbach	–	1940	550	65	18	6	55	V	Omr	F	–	30	–	H	3	110	
358	4915	Elmer Achenbach	Rapp	1958	550	92	15	6	50 + others	V	Omr	F	–	9	–	H	5	180	
359	4815	Robert S. Handelong	Frank Tomsic	1964	530	215	23	6	190,200	S	Omb	60	May 1964	9	–	H	8	270	

360	4815	Phillip A. Due	do.	1959	625	140	20	6	135 + others	S	Omb	F	–	30	–	H	7	240	
361	4915	William Mulisch	do.	1961	540	231	–	6	–	V	Omr	9	1961	–	–	H	6	235	
362	4816	Albert Greidanus	Floyd Rapp	1964	510	66	25	6	40	V	Omb	F	Oct. 1966	12	–	H	7	240	
363	4816	David D. Smith	Paul Genther	1945	590	120	40	6	–	S	Omb	50	–	–	–	H	6	170	
364	4817	Quintus Berhel	Kocher	1956	620	96	20	6	–	S	Omb	10	–	–	–	H	5	165	
365	4818	Rudolf Berhel	Rapp	1950	650	176	60	6	150,176	H	Omb	40	–	–	–	H	6	220	
366	4817	Chester Heiner	Floyd Rapp	1954	605	103	68	6	30,100	S	Omb	–	–	–	–	H	5	170	
367	4818	Clark Rissmiller	Frank Tomsic	1955	600	125	13	6	–	S	Omb	45	–	–	–	H	6	210	
368	4819	Donald Schreck	Frank Laubach	1965	730	355	15	6	–	H	Omr	70	Oct. 1966	–	.09u	H	8	285	
369	4819	Bruce Gregory	Frank Tomsic	1964	700	250	170	6	60 + other	S	Omr	60	Aug. 1964	5	–	H	4	130	
370	4820	George Handy	Frank Tomsic	1956	705	180	160	6	–	S	Omp	–	–	–		H	4	150	
371	4820	V.S. Anglemeyer	Paul Genther	1930	745	126	70	6	40,70	V	Omr	40	–	30	–	H	2	75	
372	4821	Andrew Nagle, Jr.	Floyd Rapp	1956	705	65	35	6	65	S	Omr	–	–	40		H	3	70	
373	4721	J.A. Frunfelder, MD	do.	1965	730	85	30	6	35,60,65,75	S	Omr	30	Aug. 1965	30	–	H	5	200	
374	4721	Edward Cole	Kocher	1960	670	250	28	6	below 200	S	Omr	11	–	6		H	7	220	
375	4720	Charles R. Fisher	Rapp	1956	700	45	–	6	–	S	Omr	–	–	–	–	H	3	80	
376	4720	William M. Kilpatrick	Floyd Rapp	1962	650	135	–	6	100 + other	S	Omb	30	–	8	–	H	5	165	
377	4719	John R. Detweiler	do.	1949	685	75	18	6	3 zones	S	Omr	18	1949	–	–	H	5	240	
378	4719	Mrs. George Rundle	–	–	635	120	80	6	–	S	Omb	–	–		–	H	4	145	
379	4718	Maurice Zellner	–	1940	630	85	–	6	–	S	Omb	42	–	–		H	4	150	
380	4716	Berton H. Fulmer	Kocher	1939	600	115	20	6	–	S	Omb	20	–	–		H	5	190	
381	4615	James Gava	Floyd Rapp	1957	440	154	12	6	110 + other	V	Omb	20	–	7	–	H	10	370	
382	4615	Frank Miklos	do.	1931	635	250	12	6	180,190	S	Omb	37	–	4	–	H	18	570	
383	4615	Frank Miklos, Jr.	do.	1959	645	160	10	6	80-110	S	Omb	20	–	5	–	H	15	460	
384	4616	Gerlad Davis	–	–	505	85	–	6	–	S	Omb	32	–	–	–	H	13	450	
385	4617	Paul Thomas	Raymond Werner	1965	560	120	25	6	–	V	Omb	6	1965	5	–	H	8	235	
386	4618	George Houck	do.	1961	585	120	21	6	100	S	Omb	7	–	9	–	H	9	290	
387	4620	Mrs. Raymond Hahn	Floyd Rapp	1958	685	100	–	6	–	S	Omb	–	–	–	–	H	7	200	
388	4621	John J. Correll	do.	1958	710	85	10	6	–	S	Omb	–	–	10	–	H	6	250	
389	4621	T. C. Pellegatta, Jr.	–	–	590	92	–	6	–	V	Omb	–	–	–	–	H	5	235	H_2S odor
390	4522	Edwin Filchner	Rapp	1941	660	135	45	6	–	S	Omb	10	–	–	–	H	5	210	
391	4521	Frank Kershner	Kocher	1965	670	285	30	6	3 zones	S	Omb	22	Nov. 1965	–	–	H	14	450	
392	4521	Ronald W. Teel	Marvin Butz	1966	765	110	20	6	–	H	Omb		–	16		H	8	285	
393	4520	William Sandt	Floyd Rapp	1958	670	165	–	6	–	S	Omb		–	–	–	H	7	300	
394	4519	Michael Pierzga	do.	1960	700	–	–	–	–	H	Omb	–	–	–	–	H	5	200	
396	4515	Angelo Lopresti	Kocher	1957	560	250	–	6	40-60	S	Omb	12	1957	3	–	H	23	780	
397	4420	William Gorman	–	–	620	140	–	6	–	S	Omb	17	Oct. 1966	–	–	H	14	540	
398	4422	Earl Schoeneberg	–	–	540	80	–	6	–	S	Omb	20	–	–	–	H	22	740	
399	4922	Robert Williamson	Marvin Butz	1965	815	100	95	6	–	S	Omp	F	–	–	–	H	1	<50	
400	4922	Howard Gruber	Robert Kocher	1960	810	105	60	6	85,105	S	Omp	30	1960	–	–	H	3	125	

Table 6. *(Continued)*

Well No.	Location No.	Owner	Driller	Year drilled	Altitude above sea level (feet)	Well depth (feet)	Casing depth (feet)	Casing diameter (inches)	Depth to water-bearing zone (feet)	Topo. setting	Aquifer	Static water level: Depth below land surface (feet)	Static water level: Date measured	Reported yield (gpm)	Specific capacity (gpm per ft)	Use	Field analyses of water: Hardness (grains per gal.)	Field analyses of water: Specific conductance (micromhos at 25°C)	Remarks
Np-401	4822	Nicholas Romanishan	Raymond Werner	1963	720	70	70	6	–	S	Qs	–	–	50	–	H	5	310	
402	4823	Mrs. Katy Romanishan	Floyd Rapp	1960	830	82	15	6	60	S	Omp	–	–	–	–	H	6	300	
403	4824	Paul T. Bickert	Raymond Werner	1959	815	147	–	6	120	V	Omp	4	–	–	–	H	2	55	
404	4824	R.E. Bartholemew	Floyd Rapp	1948	755	92	49	6	–	S	Omp	12	–	–	–	H	3	68	
405	4825	Alex Turoczi, Jr.	Kocher	1962	760	62	60	6	–	S	Omp	F	Oct. 1966	–	–	H	1	< 50	
406	4828	John Bucha	do.	1953	790	60	–	6	–	S	Omp	–	–	–	–	H	1	<50	
407	4728	Herbert Furry	–	–	720	96	–	6	–	S	Omp	25	–	–	–	H	3	110	
408	4727	Carl Bigley	Raymond Werner	1964	870	200	–	6	–	H	Omr	–	–	–	–	H	5	220	
409	4727	Eugene Eckhart	R.H. Odenheimer Co.	1964	745	102	70	6	–	S	Omp	–	–	–	–	H	2	70	
410	4726	Grant Wambold	Frank Laubach	–	670	47	–	6	–	V	Omp	3	–	–	–	H	2	90	
411	4826	Bum Enterprises	Robert Itterley	–	770	120	–	6	–	S	Omp	18	Nov. 1966	–	–	P	1	<50	
412	4826	do.	do.	–	770	120	–	6	–	S	Omp	–	–	–	–	P	–	–	
413	4826	do.	do.	–	830	120	–	6	–	S	Omp	29	Oct. 1966	–	–	P	–	–	
414	4726	Clyde Derhammer	Charles Itterley	1963	760	73	–	6	35 + other	S	Omr	20	–	–	–	H	2	–	
415	4725	Albert Graver	Rapp	1936	860	225	90	6	115,197	S	Omr	70	–	20	–	H	5	245	
416	4726	Thomas Graver	do.	1960	695	60	24	6	30	S	Omr	5	–	30	–	H	3	135	
417	4724	Harold Zellner	Kocher	1950	755	90	–	6	–	S	Omp	–	–	–	–	H	5	225	
418	4724	Gerald Reph	do.	1965	860	125	90	6	80,125	S	Omr	40	–	20	–	H	4	145	
419	4723	Ralph Yenser	Raymond Werner	1961	940	178	21	6	112	S	Omr	71	–	20	.5r	H	5	190	
420	4723	F. Michaels	R.H. Odenheimer Co.	1965	980	185	19	6	150,175	H	Omr	125	June 1965	10	–	H	–	–	
421	4722	Herbert Schreck	Frank Tomsic	1958	710	125	75	6	–	S	Omr	F	–	21	–	H	5	210	
422	4622	Sterling Hahn	Floyd Rapp	1959	710	75	63	6	–	V	Omb	15	–	–	–	H	3	150	
424	4623	Daniel Laubach	Kocher	1961	660	115	27	6	110	V	Omb	17	April 1961	23	.2r	H	6	260	
425	4626	Donald Hall	Floyd Rapp	1962	810	60	15	6	40	H	Omr	30	–	60	–	H	6	260	
426	4626	Lester Fehnel	Kocher Sr.	1920	765	106	–	6	–	S	Omr	20	–	–	–	H	9	500	
427	4627	Richard Shafer	Robert Kocher	1960	570	65	24	6	20 + other	V	Omr	14	1960	–	–	H	5	190	
428	4627	August Getz	Raymond Werner	1957	720	208	89	6	40, 68,89,140,200	V	Omr	33	July 1957	65	–	H	7	270	
429	4628	Forrest Beers	Kocher	1965	730	225	107	6	111,220	V	Omr	F	–	13	.08r	H	4	155	
430	4629	Francis Teel	Henry Kocher	1958	750	108	35	6	–	S	Omr	–	–	–	–	H	5	200	
431	4629	Warren Miller	Kocher	1958	805	85	–	6	–	H	Omr	–	–	–	–	H	–	–	
432	4529	Robert Minnich	Robert Kocher	1962	650	143	56	6	50,140	H	Omr	–	–	10	–	H	11	440	

433	4528	Paul Kratzer	do.	1966	520	80	40	6	–	V	Omr	–	–	20	–	H	9	330	
434	4528	R.J. Murphy	Carl Traugher	1964	530	35	20	6	–	V	Omr	5	1964	–	–	H	5	190	H_2S odor when drilled
435	4527	Era E. Roth	Henry Kocher	1960	760	–	35	6	–	H	Omr	–	–	–	–	H	6	250	
436	4527	Leroy G. Person	Raymond Werner	1965	590	60	–	6	48	V	Omr	–	–	–	–	H	8	300	
437	4526	John Shimkanin	R.H. Odenheimer Co.	1966	670	75	–	6	–	V	Omb	4	Oct. 1966	–	2.5u	H	4	125	
438	4526	Dallas Kohler	Kocher	1950	735	98	15	6	–	S	Omb	29	1950	–	–	H	7	300	
439	4525	Robert Jones	Robert Kocher	1963	770	467	–	6	–	H	Omb	70	–	<1	–	H	2	290	H_2S odor
440	4524	Paul Betull	Kocher	1961	550	65	22	6	–	S	Omb	20	–	10	–	H	7	285	
441	4523	Ronald Silfies	Floyd Rapp	1960	705	68	13	6	–	H	Omb	–	–	–	–	H	–	100	
442	4422	Ralph Lower	Henry Kocher	1964	500	104	41	6	–	S	Omb	–	–	20	–	H	7	300	
443	4423	Elizabeth Fox	do.	1956	650	110	15	6	–	S	Omb	10	–	–	–	H	6	230	
444	4423	M.E. Pike	Robert Kocher	1950	660	112	35	6	60	H	Omb	25	1950	18	–	H	15	530	
445	4424	Charles Boyko	Floyd Rapp	1951	525	140	6	6	120 + other	V	Omb	–	–	–	–	H	6	260	H_2S odor
446	4424	Mrs. Mildred Milkovits	Robert Itterley	1963	560	85	–	6	–	V	Omb	–	–	–	–	H	11	390	
447	4425	Frank Dlugos	Lester Kocher	1961	640	55	25	6	–	S	Omb	18	1961	–	–	H	9	350	
448	4426	John B. Fleck	Floyd Rapp	1940	740	75	–	6	–	H	Omb	30	–	–	–	H	9	355	
449	4427	H.B. Cheesbrough, Jr.	Robert Kocher	1935	625	90	–	6	–	S	Omb	–	–	–	–	H	5	190	
450	4323	Borough of Bath	–	1925	450	700	150	12	–	V	Omb	F	Nov. 1966	33	–	P	6	250	
451	4425	do.	Robert Kocher	1964	630	335	27	6	–	V	Omb	19	–	23	–	P	5	250	
452	4425	do.	–	1914	615	700	30	8	–	V	Omb	F	–	42	–	P	9	380	
453	4428	Craig Beltzner	Robert Kocher	1951	455	185	30	6	165	V	Omb	20	–	–	–	U	–	–	H_2S odor
454	4428	do.	do.	1951	460	85	30	6	–	V	Omb	20	–	–	–	H	7	300	
455	4429	William Eastman	do.	1952	480	102	7	6	15 + other	V	Omr	13	–	9	–	H	6	250	
456	4429	Anton Schneeberger	do.	1963	470	113	35	6	40 + other	V	Omb	15	July 1963	16	–	H	6	240	
457	4429	John Berger	do.	1954	620	103	20	6	–	S	Omr	20	–	–	–	H	11	410	
458	4329	Stephen Klutsarits	do.	1959	590	117	28	6	50,105	H	Omr	5	–	20	1.r	H	9	320	
459	4329	John Pammer	do.	1960	480	160	–	6	–	H	Omb	–	–	–	–	H	14	550	
460	4328	Edward Gossler	–	–	510	120	20	6	–	V	Omb	6	Aug. 1965	20	–	H	11	400	
461	4327	Alex McRell	Robert Kocher	1956	670	296	21	6	35 + other	H	Omb	13	–	1	–	H	11	430	
462	4327	Anthony Winarchick	Floyd Rapp	1955	655	90	40	6	70 + other	S	Omb	35	–	17	–	H	2	85	
463	4326	Wilson Jones	Robert Kocher	1966	605	180	30	6	60	S	Omb	20	–	2	–	H	–	–	
464	4326	Morvak	do.	1966	585	140	40	6	–	H	Omb	20	–	10	–	H	–	–	
465	4326	Dale R. Dech	do.	1966	590	170	20	6	115	H	Omb	12	Aug. 1966	50	–	P	10	370	
466	4325	Burnell Rex	Robert Kocher	1965	585	95	33	6	–	S	Omb	14	Apr. 1965	30	–	H	9	350	
467	4325	Mike Donello	Charles Itterley	1966	715	150	10	6	–	H	Omb	15	Sept. 1966	–	–	H	12	430	
468	4324	Mike Padula	Henry Yeska	1966	590	218	18	6	215	S	Omb	70	–	70	–	H	17	630	
469	4324	do.	Marvin Butz	1966	560	160	8	6	40 + other	V	Omb	F	Nov. 1966	70	–	I	13	520	
470	4324	do.	Robert Itterley	1966	570	145	16	6	30	V	Omb	–	–	20	–	U	–	–	
471	4225	Edwin Hess	Henry Kocher	1959	650	125	15	6	–	S	Omb	30	1959	–	–	H	24	1,050	
472	4226	Leo Schmidt	Robert Itterley	1963	530	100	10	6	40,96	S	Omb	40	–	30	–	H	16	570	

Table 6. *(Continued)*

Well No.	Location No.	Owner	Driller	Year drilled	Altitude above sea level (feet)	Well depth (feet)	Casing depth (feet)	Casing diameter (inches)	Depth to water-bearing zone (feet)	Topo. setting	Aquifer	Static water level: Depth below land surface (feet)	Static water level: Date measured	Reported yield (gpm)	Specific capacity (gpm per ft)	Use	Field analyses of water: Hardness (grains per gal.)	Field analyses of water: Specific conductance (micromhos at 25°C)	Remarks
Np-473	4227	Donald Ruch	Charles Itterley	1962	570	75	10	6	–	S	Omb	–	–	20	–	H	10	400	
474	4227	A.M. Cesaner	–	–	575	100	–	6	–	H	Omb	–	–	1	–	H	14	600	
475	4228	Anthony Herschman	Henry Kocher	1965	510	115	–	6	–	S	Omb	–	–	–	–	H	13	470	
476	4427	Duane Edwards	Itterley	1961	715	110	–	6	–	S	Omb	–	–	–	–	H	17	750	
477	4229	Jerome Hess	Robert Kocher	1966	380	125	12	6	–	S	Omb	–	–	–	–	H	8	360	
478	4730	Eugene Fritz	do.	1964	650	87	–	6	–	S	Omp	5	–	8	–	H	4	135	
479	4730	Albert Lerch	do.	1960	730	140	120	6	–	S	Omp	6	–	25	–	H	1	<50	
480	4621	Odell Kleppinger	Floyd Rapp	1966	700	103	70	6	–	S	Omb	8	Nov. 1966	–	.07u	U	–	–	
481	4731	George Pahula	Edgar Andrews	–	690	115	90	6	90-95	V	Omp	F	–	40	–	H	3	120	
482	4731	Charles Fegley	Robert Kocher	1952	660	85	22	6	–	S	Omp	23	–	–	–	H	5	190	
483	4732	Mike Lakatas	do.	1948	670	108	–	6	–	S	Omp	8	–	–	–	H	–	–	
484	4734	Eugene Ressler	do.	1964	690	100	53	6	25 + other	S	Omp	11	–	25	–	H	5	–	
485	4435	James N. Young	R.H. Odenheimer Co.	1965	560	278	15	6	133	S	Omr	133	Nov. 1965	15	–	H	–	–	
486	4431	M.D. Misenhimer	Robert Kocher	1967	725	240	25	6	44,95,233	S	Omr	8	June 1967	25	.4r, .80u	H	4	140	
487	4631	Edwin Reese	Robert Kocher	1967	700	101	24	6	30-40,82	S	Omr	18	July 1967	10	.2r,.31u	H	8	270	
488	4631	Ciro Palumbo	do.	1967	700	96	24	6	–	V	Omr	18	July 1967	–	2.57u	H	8	350	
489	4623	Thomas Saeger	do.	1967	740	250	–	6	–	V	Omr	–	–	–	–	H	–	–	
490	4521	Thomas Windishim	Floyd Rapp	1967	643	65	32	6	40,60	V	Omb	8	–	15	.5r,.50u	H	–	–	
492	4623	George Cope	Robert Kocher	1966	740	105	20	6	24, 31 + other	S	Omr	19	–	15	.41u	H	13	490	
495	4635	George Chimich	Floyd Rapp	1940	650	74	30	6	–	S	Omp	20	–	–	–	H	1	80	
496	4634	Steven Hutnick	Russell Pugh	1966	685	105	43	6	40-60 + other	H	Omp	44	–	12	–	H	–	–	
497	4633	Calvin A. Arner, Jr.	Ernest Conrad	1961	650	120	–	6	–	H	Omp	20	1965	–	–	H	3	180	
498	4534	Conrad Janca	–	1966	500	95	35	6	35-40 + other	V	Omp	15	–	–	–	H	–	–	
499	4534	David Gaugler	Charles Itterley	–	495	85	40	6	–	V	Omp	1	–	100	–	H	4	–	
500	4532	Leo Schreck	Russell Pugh	1965	660	100	22	6	Several zones 70-100	V	Omr	F	–	40	–	H	5	240	H_2S odor
501	4636	Lewis Andrews	Charles Hartraft	1954	460	97	55	6	60 + other	S	Omp	40	–	–	–	H	2	100	
502	4535	Greenzweig and Bird	C.D. Moyer	1960	570	165	24	6	–	H	Omp	50	–	40	–	H	5	220	
503	4632	Donald Kuntz	Robert Kocher	1966	700	121	22	6	55,70,116	S	Omp	23	–	30	1.r	H	7	240	
504	4631	William M. Bossard Estate	Robert Eberly	1965	655	156	–	6	–	S	Omp	–	–	–	–	H	2	80	
505	4531	E. B Minnich	R.H. Odenheimer Co.	1966	–	104	40	6	–	S	Omr	28	Nov. 1966	30	3.0u	H	4	160	
506	4530	Paul A. Lentz	–	1962	700	75	40	6	–	V	Omr	35	–	30	–	H	7	250	

507	4435	E. Dreher	Charles Hartraft	1953	400	85	–	6	–	S	Omr	–	–	–	–	H	6	300	
508	4435	Ashbell L. Musselman	C.D. Moyer	1961	395	240	40	6	–	S	Omr	40	–	–	–	H	5	240	
509	4435	D. Marshall	Russell Pugh	1965	405	205	35	6	100,205	S	Omr	25	1965	15	–	H	5	220	
510	4434	Fred Koran	Kocher	–	435	62	16	6	–	V	Omr	5	–	–	–	H	5	220	
511	4434	H. Van Bushkirk	Robert Kocher	1963	380	300	40	6	65	S	Omr	–	–	15	–	H	6	325	
512	4333	Ray Williams	Raymond Werner	1963	440	258	50	6	–	S	Omr	22	–	12	–	H	6	260	
513	4432	Robert Drey	do.	1966	465	170	60	6	–	S	Omr	26	–	12	–	H	5	240	
514	4332	A. F. Knappenberger	Gasser	1934	380	211	7	6	–	S	Omr	22	–	11	–	H	4	270	
515	4331	E. J. Balliet	Robert Kocher	1961	600	398	40	6	–	S	Omb	70	–	5	–	H	10	325	
516	4230	G. Simcoe	do.	1960	595	340	–	6	–	H	Omb	30	–	12	–	H	10	500	
517	4330	S.J. Seyer	do.	1960	400	157	40	6	–	V	Omr	F	–	5	–	H	8	350	H_2S odor

Table 7 Chemical Analyses of Water

(Results in milligrams per liter (mg/l) except field hardness, specific conductance, and pH)

County	Well No.	Silica (SiO_2)	Total iron (Fe)	Total manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$ Laboratory: Calcium, magnesium	Hardness as $CaCO_3$ Laboratory: Noncarbonate	Hardness as $CaCO_3$ Field: Calcium, magnesium (grains per gal.)[d]	Specific conductance (micromhos at 25°) Lab	Specific conductance (micromhos at 25°) Field	pH Field
LEHIGH COUNTY	Le-SP-50	7.6	0.02	0.01	3.5	1.3	2.0	0.4	12	5.7	3.7	0.0	0.3	30	14	2	1	42	50	–
	489	12	.02	.00	37	6.8	4.5	.8	68	53	7.3	.0	11	171	120	65	11	269	315	7.3
	495	18	3.6	–	12	6.5	3.6	.3	46	24	.8	.1	.1	90	57	19	2	127	160	7.2
	722	13	.04	.00	21	8	15	.6	83	50	3	.0	.0	153	86	18	5	237	290	8.25
	824	14	.04	.00	37	13	7.5	.9	90	20	46	.0	13	255	146	72	9	256	400	6.7
	1005	14	.02	.00	29	8.5	6.7	.6	42	40	27	.0	11	194	108	73	5	264	310	6.5
	1021	13	.19	.03	49	8	4.5	.3	160	29	7.6	.0	.3	202	156	25	9	320	305	–
	1022	11	.09	.00	46	8.8	8.8	.9	58	65	30	.0	24	275	151	104	10	407	395	–
	1035	5.8[a]	.15	–	22	9.0	3.2	.8	46	43	4.5	.0	10	138	92	55	6	200	210	–
	1037	12[a]	.00	–	31	4.3	3.9	.4	79	20	6	.0	9.5	134	95	32	6	209	220	–
	1040	6.9[a]	.10	–	22	8.4	2.2	1.6	66	29	4.2	.0	11	133	90	36	6	197	220	–
	1041	15[a]	.19	–	50	8.6	5.0	.4	99	75	4.7	.0	.1	221	161	80	8	318	350	–
	1042	16[a]	.55	–	29	12	7.5	.5	95	34	15	.0	0.4	181	122	44	7	267	280	–
	1043	11[a]	.08	–	30	6.8	5.3	.9	72	47	2.2	.0	2.2	150	103	44	6	222	240	–
	1044	11[a]	.02	–	49	10	7.6	.4	69	89	21	.0	.2	249	164	107	10	358	370	–
	1050	12	.08	.00	12	3.7	3.1	.6	37	8.4	4.5	.1	10	80	45	15	3	108	135	6.4
	1051	12	.00	.00	24	6.5	5.2	.7	43	35	5.0	.0	26	146	87	52	5	216	265	6.9
	1062	13	.07	–	20	5.0	4.2	.9	34	21	7.0	.0	21	117	71	43	4	166	195	–
	1067	6.4	.22	.01	13	6.6	40	1.5	100	54	12	.1	.0	185	60	0	4	308	310	–
	1068	5.6	.08	.01	29	5.4	6.7	.9	52	54	5.0	.0	7.2	141	95	52	6	223	245	–
	1106	10	.92	.08	34	9.8	8.5	1.1	76	62	8.0	.1	14	204	126	63	8	306	320	–
	1239	10	.40	.01	22	6.2	6.7	.9	60	25	6.0	.1	22	112	81	32	5	214	210	–
	1240[b]	11	2.2	.04	2	0.4	74	2	178	8.6	2.0	1.0	0.5	198	7	0.0	2	335	320	–
	1245	15	.15	.00	6	3	40	1.2	115	21	7.0	.3	.0	138	28	.0	2	246	280	–
	1269	14	.01	.00	31	7.2	12	1.2	98	36	6.4	.1	18	160	107	27	6	282	450	–
NORTHAMPTON COUNTY	NP-137	12	.07	.03	16	4.0	4.0	.2	66	10	1.0	.1	.4	87	57	3	4	128	120	–
	138	12	.07	.01	13	3.8	4.8	.2	55	11	1.8	.0	1.5	80	48	3	3	115	110	–
	145[c]	9.3	.09	.00	7.8	4.2	95	1.2	265	11	12	1.5	.0	281	37	0	3	464	450	–
	151	11	.09	.00	97	27	79	10	259	100	152	.0	13	696	353	141	23	1,100	1,000	–
	169	13	.00	.00	80	12	14	1.7	82	52	58	.0	99	488	249	182	16	632	600	–
	195	6.9	.21	.00	7.3	1.5	1.2	.4	22	7.2	2.0	.0	.2	36	24	6	2	55	66	–
	196	17	.08	.02	16	3.2	12	.3	81	9.8	2.2	.0	.0	104	53	0	4	145	145	–
	252	16	.00	.78	105	22	40	6.6	262	108	79	.0	9.6	548	353	138	19	815	800	–
	336	11	.37	.05	139	21	105	4.4	74	106	280	.0	109	935	434	373	24	1,370	1,300	–
	425	11	.07	.00	38	4.8	4.0	.8	58	42	16	.0	11	186	115	67	6	263	260	–
	439	9.5	.00	.00	5.5	2.0	61	1.2	144	27	3.0	.4	.3	175	22	0	2	282	290	–

SUMMARY AND CONCLUSIONS

The Martinsburg Formation underlies the northern half of Lehigh and North-mpton Counties, and is of Middle and Late Ordovician age. It is bounded on ne south by older Ordovician limestone formations and on the north by a ridge-orming conglomerate of Silurian age. Recent mapping has supported a three-art division of the Martinsburg into a lower thin-bedded slate (Bushkill Member), middle graywacke-bearing unit (Ramseyburg Member), and an upper thick-edded slate (Pen Argyl Member).

About three-fourths of the area is blanketed by glacial deposits of Illinoian ge. Sand and gravel of Wisconsin age are present in the extreme eastern part of ne area. The glacial deposits thin southward and westward, as indicated by using depths. A few narrow tongues of glacial deposits are 100 feet or more in hickness.

The median depth of domestic wells is about 120 feet and the median yield is bout 15 gpm. The best yields are obtained on the slopes of Blue Mountain at ne north edge of the formation. Nondomestic wells are about twice as deep and ield three to five times as much water as domestic wells. Most wells obtain water om two or three zones in the first 150 feet below land surface, but zones are ufficiently abundant to depths of about 400 feet to make drilling to this depth ractical where maximum supplies are needed. Static water levels were deepest n the uplands (30 to 40 feet below land surface) and shallowest beneath valleys 12 to 14 feet).

Wells drilled in the glacial deposits are generally less than 75 feet deep and ield two to three times as much water as the domestic bedrock wells.

The water is moderately soft and has a median dissolved-solids content of 166 ng/1. The chief ions are calcium, magnesium, bicarbonate, and sulfate. About alf the samples contain more chloride and nitrate than the amount derived aturally from the rocks, but only two samples exceeded the limit of 45 mg/1 itrate set by the U.S. Public Health Service for drinking water.

Naturally occurring hydrogen sulfide is present in about 5 percent of the wells, hiefly in the lower two members of the Martinsburg Formation. The gas is ssociated generally with sodium-rich water, which may indicate that the rocks ave not been completely flushed of the ions entrapped during deposition.

Field measurements indicate, in general, that the water becomes increasingly nineralized from north to south in the formation.

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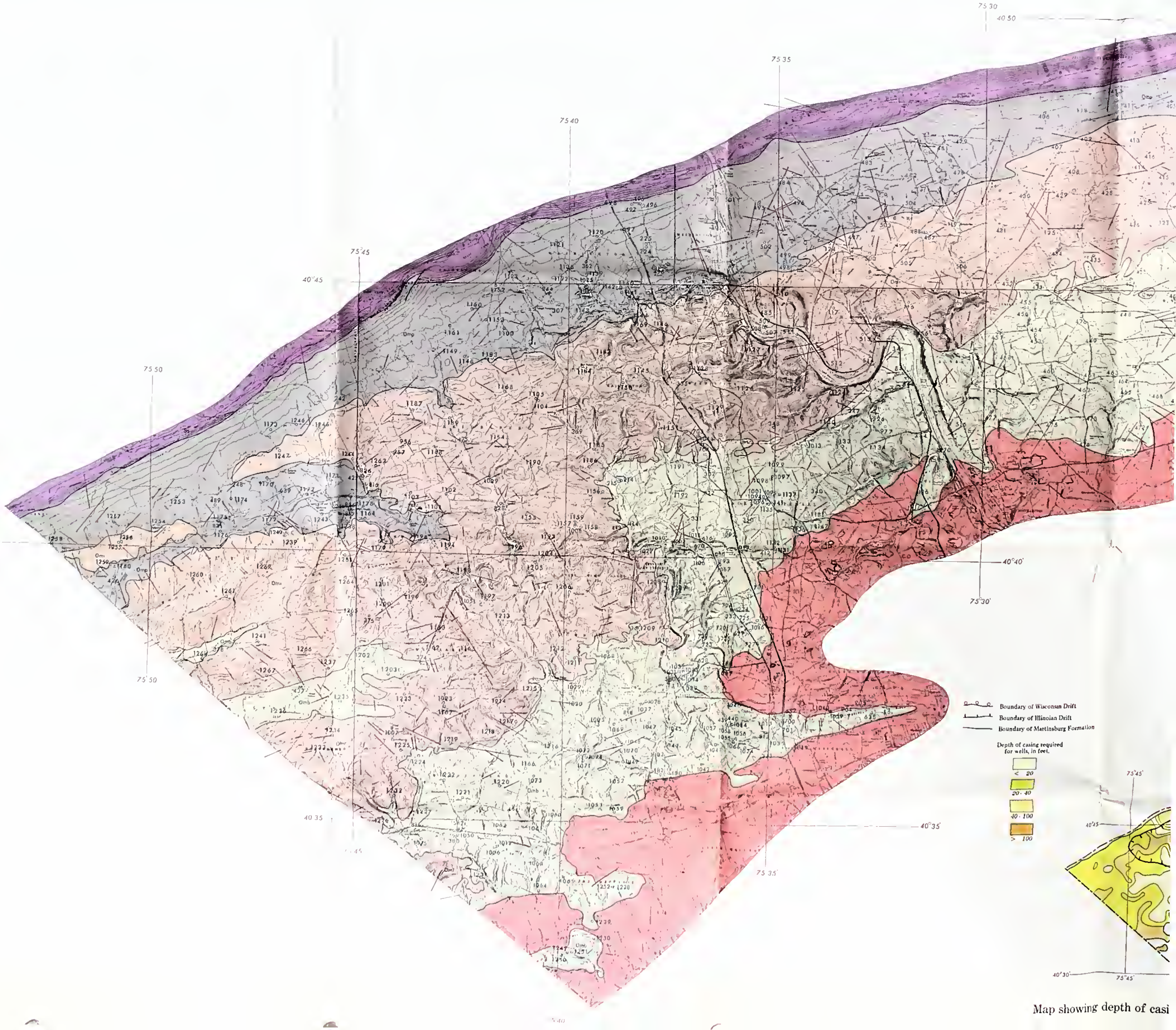
PLATE 1

GEOLOGY, FRACTURE TRACES AND LOCATION OF WELLS IN THE MARTINSBURG FORMATION OF LEHIGH AND NORTHAMPTON COUNTIES

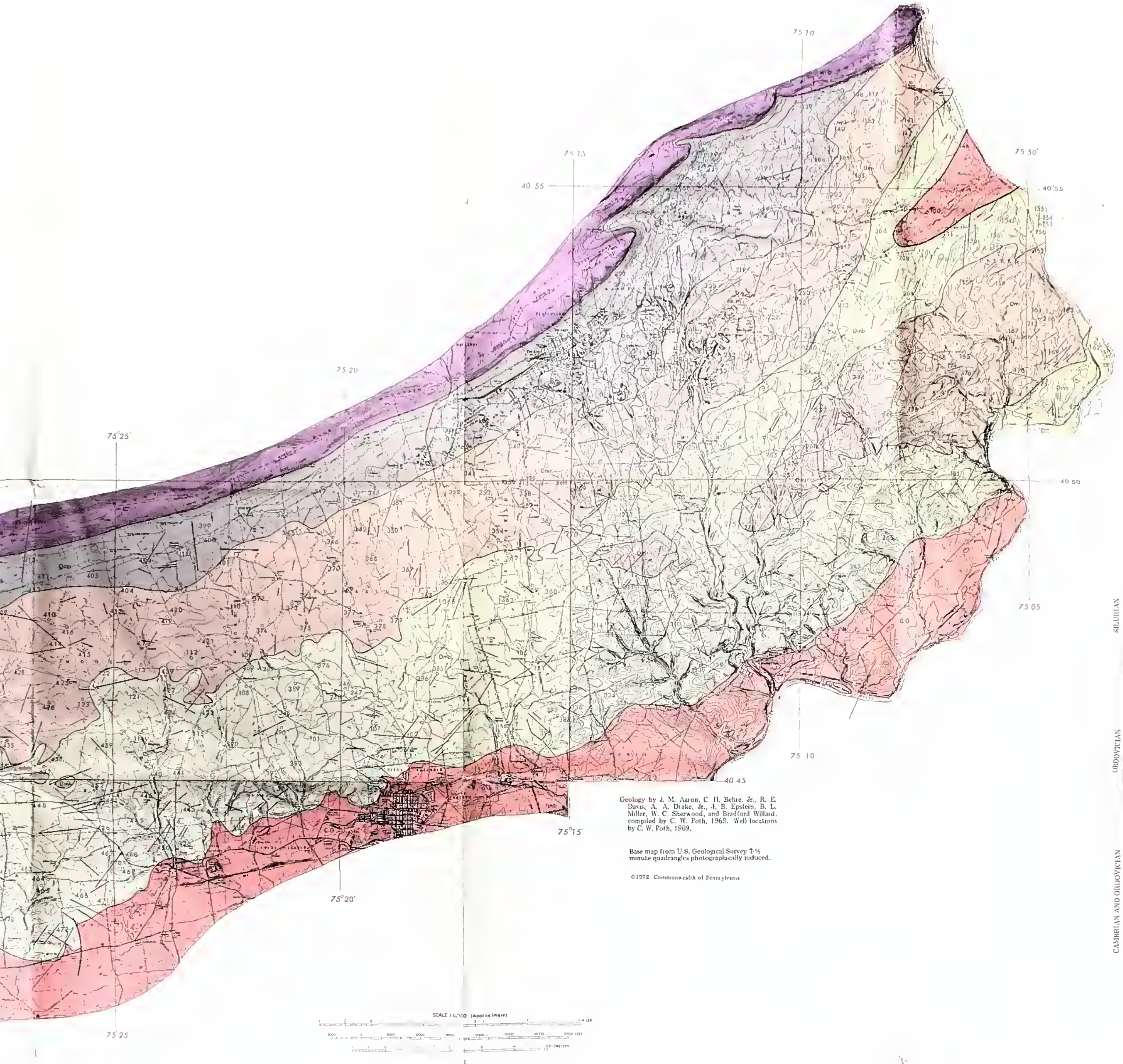
BY

C. W. POTH

1972



Map showing depth of casi



EXPLANATION

SILURIAN

Ss

Shawangunk Formation
Gray massive quartzitic sandstone and conglomerate. Water bearing properties not studied

ORDOVICIAN

Omp
Omr
Omb

Martinsburg Formation
Pen Argyl Member, Omp, dark gray to grayish black, evenly bedded claystone slate, carbonaceous slate, and lesser medium gray graywacke; yields range from 5 to 374 gpm, median yield of nondomestic wells is 144 gpm in Lehigh County and 122 gpm in Northampton County

Ramseyburg Member, Omr, alternating beds of light to medium gray claystone slate and fine to medium grained graywacke; yields range from 2 to 150 gpm, median yield of nondomestic wells is 25 gpm in Lehigh County and 17 gpm in Northampton County

Bushkill Member, Omb, dark gray thin bedded claystone slate; yields range from less than 1 gpm to 230 gpm, median yield of nondomestic wells is 26 gpm in Lehigh County and 42 gpm in Northampton County

CAMBRIAN AND ORDOVICIAN

CO

Cambrian and Ordovician carbonate rocks undifferentiated
Water-bearing properties not studied. Wells shown in fault slice along the Delaware River are in thick deposits of glacial material except well NP-148, which is reported to penetrate the Bushkill Member of the Martinsburg Formation at a depth of 139 feet.

Geologic contact

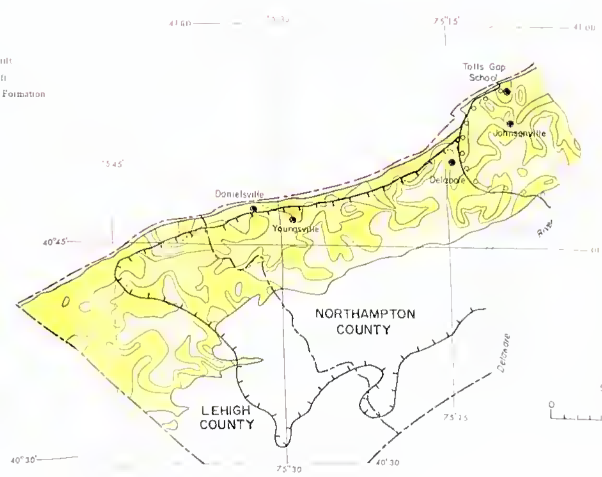
Fault

Fracture trace
(not field checked)

Well and number
See text for discussion of well numbering system

Geology by J. M. Aaron, C. H. Behre, Jr., R. E. Davis, A. A. Drake, Jr., J. B. Epstein, B. L. Miller, W. C. Sherwood, and Bradford Willard, compiled by C. W. Poth, 1969. Well locations by C. W. Poth, 1969.

Base map from U.S. Geological Survey 7-½ minute quadrangles photographically reduced.



[M]ap showing depth of casing required for wells.

Boundary of Wisconsin Drift

Boundary of Illinoian Drift

Boundary of Martinsburg Formation

Hardness of water, in grains per gallon (gpg) and milligrams per liter (mg/l)

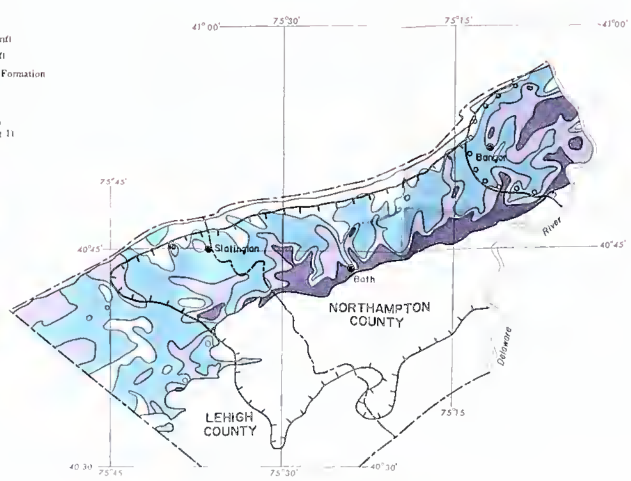
Soft
0 to 3.5 gpg
(0 to 60 mg/l)

Medium
3.5 to 7.0 gpg
(61-120 mg/l)

Hard
7.0 to 10.5 gpg
(121-180 mg/l)

Very hard
10.5 gpg
(> 180 mg/l)

SCALE
0 5 10 Miles



Map showing hardness of water.